56TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 699.

PROGRESS

OF THE

BEET-SUGAR INDUSTRY

IN THE

UNITED STATES

IN

1899,

WITH

A SUPPLEMENTARY REPORT ON THE CANE-SUGAR INDUSTRY OF THE HAWAIIAN ISLANDS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

MESSAGE.

To the Senate and House of Representatives:

I transmit herewith, for the information of the Congress, a communication from the Secretary of Agriculture forwarding a report on the progress of the beet-sugar industry in the United States during the year 1899. It embraces the observations made by a special agent on the various phases of the cane-sugar industry of the Hawaiian Islands; also the results of analyses of sugar beets received by the Department of Agriculture from the different States and Territories, together with much other information relating to the sugar industry.

Your attention is invited to the recommendation of the Secretary of Agriculture that 20,000 copies of the report be printed for the use of the Department, in addition to such number as may be desired for the use of the Senate and House of Representatives.

WILLIAM MCKINLEY.

EXECUTIVE MANSION, *May 22, 1900.*

LETTER OF TRANSMITTAL.

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 16, 1900.

Mr. PRESIDENT: I have the honor to transmit for your information, and that of the Congress of the United States, a report on the progress of the beet-sugar industry in this country in 1899.

Like the similar reports of the two preceding years, this report is composed of two parts, the first prepared by Charles F. Saylor, special agent of this Department, and the second prepared by Dr. Harvey W. Wiley, Chemist of the Department.

In the first part Mr. Saylor reports, with considerable detail, the operations of the various beet-sugar factories in the United States, including the experiences of the farmers in producing sugar beets for the use of these factories.

Especial attention is given to the construction and operation of new factories, a large number of which were completed and put in operation last year. The greatest activity in factory construction is shown to be in Michigan, where eight new factories were completed within the year. Mention is made of the companies already organized, or proposed, for the purpose of building new factories in 1900.

Reports of the experiments in the production of sugar beets conducted at the experiment stations in a number of States are given. These are mainly supplementary to similar reports made in preceding years. In several cases the station officers in charge of these experiments point out that further experimentation is not necessary to determine the possibility of growing sugar beets suitable for factory use.

A study of the cane-sugar industry of the Hawaiian Islands was made by the special agent who visited the islands for that purpose. He reports the industry to be in a flourishing condition, describes the soil, climate, and trade conditions of the islands, and gives a description of all the principal sugar plantations and factories in operation there.

The second part of this report is made by the Chemist of the Department, and contains the results of the analyses of the samples of beets received from the different parts of the country at the laboratory of the Chemical Division during the season of 1899.

These beets were grown in accordance with instructions sent out by the Division of Chemistry and from seeds furnished by the Department. They were harvested and sampled according to the printed

directions distributed to each farmer growing beets for experimental purposes.

The results of these investigations serve to point out more definitely the area best adapted to the growing of sugar beets in the United States. These areas have been provisionally mapped out, and it is a deserved compliment to the work of the Chemical Division that intending investors study carefully the provisional map prepared before locating their factories. An inspection of the location of the factories shows that all which have been erected heretofore are either directly within the area designated or immediately contiguous thereto.

The data obtained during the past year bear out in general those secured during former years, and the investigations serve to define with greater accuracy the limits of successful beet culture.

In view of the importance of these investigations and the great demand for information regarding the beet-sugar industry, I have the honor to recommend that at least 20,000 copies be printed for the use of the Department in addition to the number which Congress may in its wisdom order for the use of its members.

Very respectfully, JAMES WILSON,
Secretary.

CONTENTS.

REPORT OF SPECIAL AGENT.

REPORT OF CHEMIST.

ILLUSTRATIONS.

PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES IN 1899, WITH A SUPPLEMENTARY REPORT ON THE CANE-SUGAR INDUSTRY OF THE HAWAIIAN ISLANDS.

REPORT OF SPECIAL AGENT

CHARLES F. SAYLOR.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SPECIAL AGENT,
Washington, D. C., May 11, 1899.

SIR: I submit herewith for your inspection and approval my report for 1899 as special agent of the Department for the investigation of the sugar industry. The report for this year includes a report on the progress of the beet-sugar industry in the United States and a report on the cane-sugar industry of the Hawaiian Islands.

CHARLES F. SAYLOR, *Special Agent.*

HON. JAMES WILSON,
Secretary of Agriculture.

PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES.

CHANGED CONDITIONS.

In reporting on the progress made in the development of the beet-sugar industry in the United States, I will first call attention to the changed conditions under which this work has been prosecuted.

Most of the States that have hitherto entered into the experiments in growing sugar beets have been pursuing this line of investigation for several years. The results have been published annually in the bulletins of the State experiment stations. In most cases the investigations have been exhaustive; in some it has been demonstrated that the States have the natural conditions for growing sugar beets and manufacturing sugar from them; in others it has been shown that conditions are not favorable for growing sugar beets for factory purposes. Many of the States, upon the showing made, have not thought it advisable to continue this line of investigation any further, but have felt content to call attention to the facts already shown. In States

where these facts were favorable for the establishment of the beet-sugar industry, the energies of the States have been turned in the direction of encouraging the establishment of factories by interesting capital and promoting organizations, which is as important as any part of the work. Under these circumstances, my attention and efforts have been largely directed to investigating existing conditions. I have visited beet-sugar organizations and attended public meetings in localities where considerable interest was manifested in this enterprise, furnishing such aid in the way of information as seemed advisable, in public and private talks, newspaper interviews, and the like. These visits have been to all sections of the United States where it seemed most could be accomplished.

A number of new factories will be established, ready for the campaign of the present year. Several others will be commenced this year with a view to completing them in time for next year's campaign. In quite a number of communities throughout the United States the propriety of organizing companies and building factories is receiving serious consideration, and the probabilities are that a number of new factories will be built in the near future.

The Farmers' Interest in the Industry.

I can report considerable progress in the development of public interest in the beet-sugar industry. The agricultural press, the secular press, and writers and lecturers on agricultural subjects have devoted considerably more space and attention to the subject during the past year, and the general public is much better informed with reference thereto than it was a year ago. Among the important causes for the increase of interest among farmers the following may be stated:

SUGAR BEETS IN CROP ROTATION.

The major part of the preparation of the soil can be done in the fall, giving weed and grass seeds a chance to germinate and thus be destroyed, and giving the soil a better chance to become mellow and friable through freezing. But the main and most beneficial effect of a sugar-beet crop in a rotation is the excellent condition in which it leaves the soil for following with any other crop. The deep plowing required, the necessarily intense cultivation employed, and the clean condition in which the ground is left will show their good effects on the land for several seasons.

Farmers throughout the sugar-beet regions fully understand and appreciate the great benefits from growing sugar beets. Experience teaches them two things clearly: (1) The beet crop will pay the expense of this intense cultivation; (2) all crops are materially benefited by this good cultivation. Many farmers successfully grow sugar beets following corn, and, in fact, it is as good a practice as any, if not the best, when possible. It takes only a little more work to prepare the

ground, and the beet crop gets the benefit of the cultivation of the land during the previous year.

We have only to investigate the conditions prevailing in localities that are limited to one or even two kinds of crops to see the disadvantage of limited crop resources. Sugar beets add an important crop to the already extensive resources of the Mississippi Valley.

RELATION OF SUGAR BEETS TO STOCK FEEDING AND DAIRYING.

There is no better settled proposition than that the manufacture of beet sugar affords an opportunity for establishing these industries on the most economical and successful basis. The beet pulp is a cheap food, and in a food ration gives results not attained by any other element entering into any other ration. This comes not so much from the inherent nutrition of the pulp as from its ability to make the most of the other food eaten by the animal, making available the nutrition in the ration as a whole. I have been advised by some of the largest and most successful stock feeders in the country, after extensive experiments made by themselves, that, with pulp as a part of the ration, they were able to put steers on the market in three-fourths of the time, using the same amount of grain daily as is ordinarily fed; and it is the universal verdict of dairy feeders that no other kind of ration produces nearly such results as one containing sugar-beet pulp. I have seen whole valleys on the coast covered with the dairy industry and milk trains running to San Francisco, where nothing of the kind existed before the introduction of the pulp and where they were not possible without it.

MONEY RETURNS AND OTHER BENEFITS.

Instead of crude material, the farmer should furnish as nearly as possible finished products. This principle applies to the beet-sugar industry. In no other direction has a large area of this country, East, North, and West, such inviting prospects; especially is this true of the Mississippi Valley. It seems we are destined to clip our wool and send it to New England where the busy hum of the factory transforms it into useful textures to clothe ourselves and the rest of the world. The native of Iowa, for instance, passes through the various stages to manhood and down the decline, and his ears may never have heard the music of the spindle. The beautiful, finely-developed cattle from the meadows and pens are sent away and returned as beef prepared for the table, thus diverting the bulk of the profits to others who have contributed very little to the production, and preventing the advantages which would result from having the work done by local labor and capital. But here is a chance in the sugar industry to see the factory and farm side by side, working to produce one of our articles of food and luxury. Here is a chance to hear the hum of industry, the music which thrills and inspires the soul of man, brightens and gladdens the

home, amalgamates and develops our social organism. We look out and see those restless volumes of smoke issuing from chimneys early in the morning and late at night, denoting that our own coal, mined by our own people, is working up a product of our farms in a factory manned by our own laborers, who buy of us the necessaries of life, and we feel compensated to some extent, in spite of the fact that many of our other crude materials are compelled to seek manufacture in other sections of the country.

But this is not the only compensation. We must consider the direct benefits to the farmer of growing sugar beets for the factory. It has been my province during the last three years to visit all of the beet-sugar sections of the United States, where beets are being grown on a large scale and sold to factories, and I can speak from actual observation in regard to the benefits. Of course, beets grown in different parts of the United States are grown under different conditions, which will affect, to some extent, the cost of production and the profits incident thereto. Speaking conservatively, I shall lay down some general facts which will give an idea of the average profits to the farmer in sections of country where beets are produced under rain conditions, and where the cultivation is similar to that which would be necessary in Iowa, for instance. A fair estimate of the cost of producing sugar beets in Iowa would be about $30 per acre. This allows for every element of cost entering into the production of the beets. It allows the farmer $2.50 a day for himself and team, and the laborers whom he may employ $1.50 per day. A great deal of the work can be better done by boys from 12 to 16 years of age at a somewhat reduced rate. The universal price of sugar beets at the factories in the different parts of the United States is $4 to $4.50 per ton, but I will use the minimum price of $4 in making this calculation. My investigation of the production of sugar beets in other localities leads me to say that Iowa can readily produce from 12 to 15 tons per acre on an average. Of course, some years under extraordinary conditions some farmers might produce as high as 25 tons an acre. I have known of even larger yields than that. Some years under poor crop conditions some farmers may produce as low as 5 or 6 tons to the acre, but these would be extremes in either case. Going back now to our average, the farmer that produces 12 tons per acre receives $48 per acre for his crop, or $60 on a crop of 15 tons. His profits over and above all expenses would be $18 on the smaller, or $30 on the larger crop. Of course, the farmer that produced 25 tons per acre would have an enormous profit, namely, $70 per acre, or enough to buy the best land in the State of Iowa. I know of no other single product which can be grown on the farm to any considerable extent that will compare with this.

Farmers are inclined to look too much at the element of cost, and say that $30 is a snug sum of money to pay for producing an acre of

anything; but they should consider this as they would any other business proposition. Will the profits justify such an outlay? If so, the proposition to raise sugar beets is a good one. Before the farmer can produce fattened steers to any great extent he must make an investment in the stockers. And is it not a fact that, after making such investment, he is not nearly so highly compensated as he would be if he made the same investment in labor and expense necessary to produce sugar beets? Doubtless the experience of each farmer himself will be the best answer to this question. I may make the same illustration with the dairy cow. Before he can go very extensively into this business the dairyman must first buy the cows and build his barn. He does this because he figures that he is going to be a gainer thereby, and that is the one basis upon which the farmer should settle the question of raising sugar beets.

I have studied very carefully the history of the starting of all the factories in this country, and without exception it has been difficult to get the farmers in the beginning to contract to raise the beets, but after an experience of one or two years it ceases to be a question as to who can be induced to sign the contracts, and becomes a question among the farmers as to who can secure the contracts.

Another beneficial feature of the sugar factory in a community is that an outlay of $30 to produce an acre of sugar beets means a large outlay for labor in the vicinity, as the large expense of producing beets is for labor. In case of a town of several thousand inhabitants and the community surrounding, it is a fact that everyone that wants work can get it, and I believe it to be true that savings banks in towns where factories are located have a larger number of depositors than in other places on account of the large amount of labor involved in the production of the beets and the manufacture of the sugar. When we consider that the money secured for the finished product comes back almost entirely to the community in which the factory is located, we begin to see the blessing of a sugar factory. This money goes for coal, for labor, for transportation, for limestone, and many other crude materials. About the only thing taken away by the people controlling the factory is the profits, and if it happens to be a factory that is organized by local people, then the profits themselves remain to enhance the riches of the community.

Progress of the Industry in the Various States.

So many of the States have now actually established factories, which every year are turning out a good grade of refined sugar made from sugar beets, that we are afforded the best opportunity there is for obtaining information as to the condition of those States for raising sugar beets and manufacturing sugar. The information thus gained is much more valuable than that obtained from scientific experiments because it gives us the practical results themselves and that is what we are striving for.

Believing a detailed account of the results of these factories, so far as obtainable, to be the best evidence, I give in succeeding pages as specific and detailed an account as I am able to make of the working of each factory during the past year. Most of these factories were visited personally by me, the crop and the crop conditions were observed at some time during the year, and, from personal observation supplemented by information received from others, I have compiled the history of the year's work.

CALIFORNIA.

California has been manufacturing sugar from the beet root for the last thirty-three years. She has the distinction not only of having the largest factory in the world, but the oldest factory in the United States manufacturing sugar from beets; and, when we consider the comparatively short time in which sugar has been commercially manufactured from beets, this puts California almost among the pioneers of the beet-sugar industry.

Up to last year California had no serious competitor for the honor of being the leading State both in the number of factories and amount of sugar manufactured; but Michigan's record last year jumped from one to nine factories, which gives her the lead of one over California in the number of factories in operation, although the combined output of the factories of California is still considerably larger than that of Michigan.

California possesses conditions for growing sugar beets that are peculiarly her own. Her soil and her moisture supply for growing a crop are different; in fact, it might be said that the conditions that obtain throughout are different from those prevailing where sugar beets are grown in other mountain States, such as New Mexico, Colorado, and Utah, and radically different from the conditions that prevail in the Mississippi Valley, Michigan, and New York. In the first place, beet growing in California depends largely on a thorough saturation of the soil by rainfall prior to and up to the time of planting. It is a peculiarity of these soils that, if they are so saturated, they have the power of conserving this moisture so that, with the aid of occasional slight showers, they will produce a bountiful crop of sugar beets. Indeed, California will produce a bountiful crop without the aid of the showers provided the soil is saturated in winter and the beet plants succeed in getting a good start. In the other mountain States sugar beets are grown almost entirely with the aid of irrigation, while but very few of those produced in California are grown by irrigation. In the Mississippi Valley, Michigan, New York, and other Eastern sections, the growing of beets depends largely on the rainfall during their growing season.

Under right conditions California can probably grow a larger tonnage and produce a beet that will run higher in its average sugar content

and purity than any other section of the country; but the trouble with California, demonstrated by the experience of the last four years, is that the beets are not at all a reliable crop in the State, especially in southern California. In this section for the last two years beets grown for some of the factories have yielded only a small part of a crop. One factory in 1898 had a campaign of only one week, followed with a campaign of only four or five weeks in 1899, while other factories in the southern section have only run from one-third to one-half their usual time. This droughty condition has affected all the factories in California for the last two or three years. It seems to grow less in effect as we approach the northern section of the State, but even here none of the factories have had anything like a good supply of beets such as they might have anticipated under favorable conditions. This situation, if it shall continue, is bound to affect seriously the reputation of southern California as a sugar-beet section unless the farmers shall devise means for furnishing moisture to their crops through irrigation.

ALVARADO SUGAR COMPANY, ALVARADO, CAL.—Taking up in detail the progress of the sugar industry in this State, we have first the Alameda Sugar Company, of Alvarado. This is the pioneer plant in the United States for the manufacture of sugar from beets. This company and its progenitor have been making sugar out of beets at Alvarado for thirty-three years. The originator of the business was the elder Dyer, of Alvarado, now retired on account of declining years. Through his enthusiasm and persistence the factory at Alvarado continued to make sugar out of sugar beets in the face of all opposition, vicissitudes, and adversity. The enterprise itself had to fight its way into public favor as a feasible proposition. The product had to run the gauntlet of all kinds of critics as to its purity, quality, and desirability. These questions have all been settled, one by one, as the beet-sugar industry has established itself on its merits in this country.

In occasional publications the credit for this pioneer work is given to someone else, but it must not be forgotten that Mr. Dyer, through these early years, freely gave his money, energy, and ability to the work of agitation, and the building up of the beet-sugar industry. He not only kept this factory going year after year, in spite of the odds against him, but in season and out of season he advocated the adaptibility of California for producing sugar beets and manufacturing sugar. The history of subsequent events in the establishment of these eight large successful sugar factories in California has proven the wisdom of his course. Through his recommendation and influence, three of his sons and two of his nephews thoroughly educated themselves in the art and science of beet sugar making; also in factory designing and construction, and they are devoting their lives to this work. The Alvarado factory doubled its output in 1897, and the parties interested in it also organized and built the factory at Santa Maria later. The Alvarado factory now has a daily capacity of 900 tons. It harvested last year 3,800 acres of beets,

and worked 36,739.9 tons. The farmers received for their beets an average of $4.56. The factory produced during the campaign 3,898⅔ tons of sugar.

WESTERN BEET SUGAR COMPANY, WATSONVILLE, CAL.—The Watsonville factory has been one of the most successfully operated factories on the Pacific coast. Its daily capacity is 1,000 tons of beets, being the largest operated in the United States prior to the construction of the new factories which began work in 1899. Mr. Claus Spreckels of California, the well-known Hawaiian sugar planter and manufacturer, who early became interested in the beet-sugar industry in the United States, and especially in the State of California, organized this company, being the chief capitalist in it, and built the factory about ten years ago. It was fortunately located, has always been able to secure a good supply of beets, and has made a successful record throughout its career. In 1898 Mr. Spreckels also organized the Spreckels Sugar Company, which built a mill near Salinas, Cal. Owing to the extensive capacity of the Salinas factory, and the impossibility of securing sufficient acreage for it the first season, 1899, the beets for the Watsonville factory were taken to Salinas and worked up along with the beets raised in that locality. This left the Watsonville factory idle the past season. I understand the Watsonville factory has recently been transferred to the company at Salinas; that both factories will be worked under the same management hereafter; and that, as soon as sufficient acreage can be worked up in Salinas Valley to supply the factory there, the Watsonville factory will be put in operation again working up the beets of its own territory.

AMERICAN SUGAR COMPANY, CHINO, CAL.—The Chino factory was the third in the order of introduction into the State of California. The season of 1899, like the two preceding seasons, has been so dry that the farmers have not been able to produce sufficient beets to keep the factory running a full campaign. This factory has a capacity for working 750 tons of beets daily. The campaign this year commenced August 26. The slicing closed October 29, giving it a run of 65 days, about half of a full campaign. It averaged during this time about 725 tons of beets daily; while the tonnage per acre was not very large, the quality of the beets was quite superior, the average running over 16 per cent of sugar in the beet. This is a remarkable showing, in view of the fact that most of the beets grown for the Chino factory are grown year after year on the same ground. The quality of the beets does not seem to deterioate in any way, but it is very likely that this succession of beet crops is having an effect on the tonnage produced, although the shrinkage is usually attributed to drought. I clip from the Sugar Beet Gazette of Chicago some very interesting items that paper secured from the management of the Chino factory, showing the quality of beets worked, the consumption of raw materials, and the production of the factory during the campaign as follows:

The Chino (Cal.) beet harvest was completed October 14. The sugar percentage was kept well up and continues remarkably high for this late in the season. The work at the factory for the week ending October 11 was as follows:

Results of a week's work at the Chino factory.

Day of the week.	Tons sliced.	Per cent sugar.	Bags sugar.
Thursday	707	17.6	2,278
Friday	789	17.9	2,090
Saturday	801	16.1	2,265
Sunday	377	19.3	1,625
Monday	729	18.4	2,005
Tuesday	634	17.5	1,035
Wednesday	789	15.7	2,700

The following are a few items of the campaign, kindly furnished us by the management:

Tons beets sliced	44,336
Pounds sugar produced	12,956,400
Paid for beets, over	$225,000
Paid for labor	$60,000
Men employed	350
Barrels oil used	50,000
Tons coke used	900
Tons lime rock used	9,000
Sugar bags used	129,664

Besides these materials, the factory used thousands of yards of filter cloths and other necessaries in the work. There was some molasses from last year and several cars of raw sugar were also worked.

It is understood that the ownership of this factory, the factory at Oxnard, and those at Grand Island and Norfolk, Nebr., have all been merged into one company, and that in the future they will be known as properties of the American Beet Sugar Company. This company was organized by Mr. Henry T. Oxnard, of New York City, for the purpose of absorbing the above plants, all of which he was instrumental in organizing and building. It is also claimed that this company will locate and build other factories throughout the United States from time to time, the next one being at Rocky Ford, Colo., for 1900. Mr. Oxnard has been one of the most indefatigable organizers of the beet-sugar industry in this country.

Los Alamitos Sugar Company, Los Alamitos, Cal.—The Los Alamitos factory was the fourth in the order of introduction in the State of California. In its construction and arrangement it is looked upon by manufacturers as a model in every way. It started out with a capacity of 350 tons of beets daily and began its first campaign in 1897. The section of country supplying this factory with beets prior to this year was a large sheep ranch, but its success the first year in securing beets from these new and untried lands was so pronounced that the factory was encouraged to go ahead and double its capacity, which it did, giving it a capacity of 700 tons of beets daily. During the years of 1898 and 1899 climatic conditions have been exceedingly unfavorable for raising sugar beets. The factory only secured enough beets in 1898

to run seven days, and during the past year the factory was in operation only twenty-one days. This has been a very discouraging experience, but in view of the fact that the whole of southern California has experienced during that time an unprecedented drought, the managers of this factory are disposed to continue their efforts until normal conditions shall obtain once more. The factory succeeded in working about 11,000 tons of beets, from which they manufactured 1,100 tons of sugar.

California Beet Sugar and Refining Company, Crockett, Cal.—The capacity of this factory is 1,200 tons. Here, also, the supply of beets was limited on account of the drought during the past growing season, and they were able only to secure about half the usual supply. This company is organized for both refining and manufacturing purposes. It is the purpose of the company to manufacture sugar from sugar beets during the sugar-beet campaign and to refine Hawaiian raw sugar during the rest of the season. This would seem to be a very good plan, inasmuch as the beet-sugar factories are usually idle at least eight months in the year under the most favorable circumstances. It would seem to be a good business policy to have the capital invested in the factory employed the year round, the machinery being used in refining when it is not employed in manufacturing sugar. I understand that some other companies are considering the feasibility of adopting the same plan. This policy, however, should be kept in view in the construction and arrangement of the factory from the beginning.

American Beet-Sugar Company, Oxnard, Cal.—This factory was commenced in 1897 with a view to working in the campaign of 1898, but owing to the drought the management decided to ship the beets to Chino and have them worked in the factory at that place. This year the factory made a short run, closing down October 27, the balance of its crop being worked up at Chino as in 1898. It seems that the rains retarded the harvesting operations; also that it was difficult to secure labor sufficient to keep up with the enormous demand of this factory for its daily run of beets, which is 2,000 tons. It opened its campaign August 16. The total amount of beets raised and harvested for this factory was 101,000 tons, but about one-third of this amount was taken to Chino.

The Oxnard Courier makes the following detailed statement with reference to the amount of sugar produced, the beets worked, and crude material used by this factory in 1899:

Tons beets sliced	63,712
Pounds of sugar produced	16,785,400
Amount paid for beets	$439,000
Amount paid for labor	$80,000
Men employed	550
Barrels of oil used	71,487
Tons coke used	902
Tons lime rock used	8,228
Sugar bags used	173,513

The plan by which this company proposes to regulate the price it is to pay farmers for beets for the season of 1900 is quite a departure from what has been the custom heretofore, and is as follows:

They will pay for beets containing 12 per cent of sugar $3.25 per ton and 25 cents additional for every 1 per cent of sugar above 12 per cent. A beet containing 11½ per cent of sugar is rated at 12 per cent, one containing 12½ at 13, etc. If for any cause the beets should run below 11½ per cent sugar, a deduction of 50 cents per ton for every 1 per cent of the deficiency will be made; but it is very rarely that beets run as low as this The company will pay the freight from the railroad station nearest the farmer to Oxnard, thus putting the growers in all localities on an equal footing and permitting them to get the highest returns for their crop. The tests for the percentage of sugar are made at the factory for each load or from each car as delivered, and the farmers at Oxnard are allowed to employ a check chemist to verify these tests. The company will furnish the seed at 12 cents per pound, which is supposed to be cost, and the amount will be deducted from the first delivery of beets.

SPRECKELS SUGAR COMPANY, SALINAS, CAL.—This large factory was commenced in 1898 and completed in time for the campaign of 1899. It is about 5 miles from Salinas, and the beets are grown in Salinas Valley for 50 miles each way. This is a large and beautiful valley. There are at least 80,000 or 90,000 acres available for the production of sugar beets. A little over 20,000 acres were planted the past year. It is the intention to increase the amount of land for growing sugar beets to 35,000 acres in 1900. The factory has a capacity for working 3,000 tons of sugar beets per day. It is the largest factory in the world, which is an indication of the energy with which this new industry is starting in America. This factory receives its water from a system of wells. It requires about 13,000,000 gallons per day. Sugar beets are cultivated in the fields by Japanese laborers, who receive 90 cents to $1 a ton, which covers the cost of weeding, hoeing, thinning, and bunching until the crop is ready for the market. The early part of the season was quite dry, but by July every indication was promising for a good crop.

The parties who operate this factory have also been operating the factory of the Western Beet Sugar Company at Watsonville. It was decided to be best to close down the Watsonville factory for this campaign and to ship the beets to the Salinas factory. It is the intention of the proprietors to secure enough acreage in future to operate both these factories for full campaigns. The Salinas factory started up August 7 for a trial run, but the regular work of the campaign began later, and finished February 13. It sliced 175,000 tons of beets and produced 20,000 tons of sugar.

UNION SUGAR COMPANY, SANTA MARIA, CAL.—This company was organized by the same parties as those interested in the factory at Alvarado. It has a capacity for working 500 tons of beets daily. To supply this factory 6,500 acres of beets were planted. In the early part of the season, about June 1, the outlook was very encouraging for a large crop of beets. It was estimated at that time that the supply would

reach 80,000 tons. Owing to the drought only 3,000 acres were harvested. The drought was not the only drawback met in growing the sugar beets during the season of 1899. The beets were very badly affected by beet blight, called by the management "bacteriosis." The factory began slicing beets September 20, and its campaign extended seventy days, during which time it worked 16,000 tons of beets and produced 1,607 tons of sugar.

NEW MEXICO.

PECOS VALLEY BEET SUGAR COMPANY, CARLSBAD, N. MEX.—The introduction of this factory in New Mexico three years ago has been the means of settling some points on which authorities were not agreed before. It is said to be the only factory in the world where sugar beets are grown entirely by irrigation. There had been some experience in growing beets partially by irrigation, and it was claimed that they would not succeed where the entire amount of moisture used was supplied in this way. The results at Carlsbad have demonstrated that the opposite is true—that sugar beets can be successfully grown by irrigation. It has been a valuable lesson to the country as a whole. It has demonstrated the possibility of bringing into use other arid lands in connection with this profitable industry. With the sugar beet as a main crop, with alfalfa, small grain, potatoes, etc., in rotation, and with the addition of the dairy and creamery, these sections will fill an important place in the agriculture of the country. The factory at Carlsbad pays a flat price of $4.75 a ton for beets, and the feeding and dairy industries have already developed to a wonderful extent. The factory itself fed last year 6,000 head of sheep. One of the advantages claimed by beet raisers in this section is that by the aid of irrigation their planting season is longer, ranging from April 1 to June 15. This results in a prolonged season for harvesting, which can continue throughout the campaign of the factory, the beets staying in the ground until used, thus avoiding the necessity of siloing, etc. Owing to the absence of rain there is no danger of loss from second growth of the beets in the fall.

This factory is hampered a little in having such a small working capacity. It was originally unfortunate in its design. It was first operated in Canada, then taken down and rebuilt at this place, and to make it an up-to-date factory, thorough in all its parts, as it is to-day, required considerable outlay. As to the quality of its product and the success of its work, it is up to standard, but the smallness of its capacity must necessarily require a higher rate of expense to produce sugar. It has been very fortunate in its management, and it is largely due to this fact that this little factory has been enabled to do the pioneer work in a new and untried section of country where labor is scarce, where the agricultural conditions were so little known, and to do this work so well. During the irrigation season, which extends from March 1 to October 1, 8,881 acres of cultivated

land received 33,923.21 acre-feet of water. An acre-foot is 43,560 cubic feet, and it takes about 7½ gallons of water to make a cubic foot. Shortly after the middle of November the valley received two days' heavy rain, which retarded the time of harvesting. All things considered, the crop was fairly good. The factory closed the slicing of beets January 22, after a campaign of 109 days. It worked 30,000 tons of beets and manufactured 2,950 tons of sugar.

UTAH.

The beet-sugar industry was first introduced into Utah at Lehi in 1896. There are some peculiarly favorable conditions in Utah for starting almost any kind of an enterprise that has back of it the agricultural resources of the State upon which it depends. The people of this State have well learned the lesson of toil. Under the conditions and circumstances which have existed here for half a century these people have had to live within themselves, and it has been by their industry and the intelligent direction of their organization that the otherwise arid regions have become fertile valleys, cut up into small farms of from 5 to 40 acres. These people have learned well the lesson of economy and industry. They have learned how to produce most from their small farms. From the first, irrigation systems were started, and they grew with the development of settlements. Everything like ditches and roads was on a system of cooperation; in fact, everything for public convenience and use was projected and directed from the head center, the Mormon Church. This placed where it was needed an irrigating ditch of a kind and durability which would last with the land itself. There is probably no place in the world that has a more durable and complete system of irrigating ditches than the State of Utah, where they were provided under the old régime. When a piece of land was blocked out for a farm and water was turned upon it, it was with the absolute assurance that the supply of water would be sufficient to take care of the crops on the land under any circumstances of drought. The necessities of the case demanded that these lands should be well and carefully tilled and that they should be put to growing crops that would yield the most for the smallest amount of ground. These are the conditions under which the beet-sugar industry was introduced into the State of Utah. There could not be agricultural conditions more favorable to the growing of sugar beets, whose requirements are intensive farming in every sense of the word. They require intelligent, painstaking, and well-directed labor, and this could be met best on small tracts, where the farmer is not overcome in the beginning with the volume of work necessary, as sometimes happens in other sections, where the farms are larger.

The first factory was organized, equipped, and managed through the Mormon Church itself, and from the beginning has proven a great success. No pains nor expense have been spared to put the factory on

the very best footing possible and have it equipped with the most modern and labor-saving appliances. The results of this factory's success in Lehi have inspired the organization of another company, which established a factory at Ogden. Without doubt in the near future several other sections of the State will have factories, and Utah will be rated in agricultural resources chiefly for her sugar production. The work of the factories for the last year will now be taken up in detail.

UTAH SUGAR COMPANY, LEHI, UTAH.—This factory has a capacity of 350 tons of beets per day. This capacity is being doubled for the campaign of 1900, so that the factory will have a capacity for working 700 tons of beets daily. In addition to this the factory acts as a sort of central plant for another, a subfactory, located at Springville, about 30 miles away. This subfactory extracts the juice from the beets, which is then limed and passed through a pipe by means of gravity and pumping to the main factory, where it is worked up into sugar. This Lehi factory is also arranging to put in another slicing station, or subfactory, in the opposite direction, the juice from which will be conducted down in the same manner by the use of a pipe line. The capacity of this factory for next year's campaign, with all its slicing resources combined, will be 1,200 tons of beets per day.

The introduction of this central plant idea at Lehi is one of the features of last year's progress. The feasibility of the plan has been a mooted question. It has been discussed considerably in this country by those interested in the development of the industry. Some have claimed that such a system would be desirable and should be introduced where practicable. Others have asserted that this idea of a central plant with branches or stations has been tried in every form and has not proven successful. If this experiment at Lehi shall prove to be a success it will demonstrate the feasibility of erecting a large central plant at some advantageous point and having pipe lines radiating out from this in different directions to slicing stations fitted up with diffusion batteries and lime mixers to extract and prepare the juice, which will finally be forced through the pipes to the central plant. This saves hauling the beets and brings a larger radius of farming country into close contact with the sugar factory. The farming community and interests around these slicing plants will have all the advantages and benefits of being located near the factory itself, because their crop would not require shipment by railroad and the pulp will be at the slicing station, convenient for use. I consider the introduction of this central-plant idea a matter of great importance as affecting the future status of the beet-sugar industry in this country.

The sugar beets for the Lehi factory were grown under very favorable conditions. A large tonnage per acre was secured, and the beets ran quite high in sugar. The factory worked during the campaign 52,650 tons of beets and manufactured 7,192 tons of sugar.

OGDEN SUGAR COMPANY, OGDEN, UTAH.—This factory was the second one built in the State of Utah. It has a capacity for working 350 tons of beets daily. In 1899 the conditions were fairly good for producing a crop in this section, and the factory began operations September 15, this being its second campaign. It is located in a good quarter of Utah, and a successful career for it is anticipated. About 32,000 tons of beets were received at the factory this year. This indicates that about $144,000 was paid out to farmers. The amount of beets received at the factory fell short of the estimates about 8,000 tons. The sugar content of the beets was not nearly so high as it was last year. The farmers did not receive as large a tonnage per acre. On the whole, the operation of the sugar plant in 1899 can not be said to have been as successful as it was the year before. The critics among the sugar-beet growers said that the trouble was largely due to overirrigation. It may be mentioned in this connection that those best informed on irrigating sugar beets give the strongest caution against using too much water or using it too often. It would be well for companies starting new factories where sugar beets must be grown by irrigation to profit by the experiences of Ogden, Lehi, and Carlsbad.

NEBRASKA.

Next after California in taking up the beet-sugar industry came the State of Nebraska with two plants, located at Grand Island and Norfolk. These enterprises were organized by the Oxnards, principal among whom was Mr. Henry Oxnard, who was mentioned in connection with the factories at Chino and Oxnard, Cal. It is said that these two plants with the two above mentioned are now the properties of the American Beet Sugar Company, and will in the future be operated by said company in connection with the one that this company is now building at Rocky Ford, and others that they anticipate building in the future. It was largely through the operation of these two factories that the Rocky Mountain States and the northern Mississippi Valley States acquired information regarding the beet-sugar industry. These two factories have been the objective point of many visiting committees, commissioned by boards of trade, agricultural societies, and other organizations to gather as definitely as possible facts pertaining to the beet-sugar industry. Managers of these factories have always treated such committees courteously, showing them through the factories, and giving out such information as would furnish their visitors the most enlightenment with reference to this industry. Taking the complete history of the factories from their beginning, about ten years ago, they have been successful on the whole. In the earlier stages considerable friction developed between the management and the farmers, but as each has come to understand the requirements of the other better their relations have become much more smooth in the last few years. These factories are probably not as fortunately located as they could be at

the present time under a wider and more definite knowledge of the agricultural conditions of the State in relation to successful beet growing. Grand Island is a little too far west in Nebraska for first-class crop conditions, for the soil has a tendency to be too sandy and the climate a considerable tendency to be too dry. This tendency to drought and sand also prevails more or less in the region of the factory at Norfolk.

It was through the fact that there was so much sandy soil around these factories that the people in other States got the idea that sandy soil was necessary to make a success of growing sugar beets. This idea is being dispelled, and the facts made known by the experiment at Ames, Nebr., on the part of the Standard Cattle Company, which plants in sugar beets, year after year, several hundred acres of the heaviest black, bottom-land soils. These soils have been returning a large tonnage per acre of beets of good quality and purity, and crops are much more sure. This same company grew last year for the new factory which was erected on its lands 2,000 acres of beets.

American Beet Sugar Company, Grand Island, Nebr.—It is stated that the company has adopted the rule that all its factories in Nebraska and California will pay a flat price for beets shipped by railroad, and in the case of beets so shipped for a distance of 50 miles or less they will pay the freight rates. This factory did not receive its usual amount of beets in 1899, but its run, though short, was successful. Most of its hands were able to get out in time to take up work with the new factory at Ames, which was late in completion. The factory has a capacity for working 350 tons of beets. I am not able to give results of last year's campaign.

American Beet Sugar Company, Norfolk, Nebr.—This factory has a capacity for working 350 tons of beets daily. It is in the center of a large feeding district. Thirty thousand head of sheep were fed around this factory last year. It is also a large cattle-feeding district. These cattle and sheep-feeding industries make a demand for the pulp, and the pulp on the other hand creates a demand for the cattle and sheep. The same can be said with reference to the feeding industries of Grand Island, Nebr. The crop conditions around Norfolk were very good last year, and the quantity and quality of the beets supplied to the factory were quite encouraging both to the factory and to the farmers. I am unable to give at this time the actual results of the campaign.

Standard Beet Sugar Company, Ames, Nebr.—This factory was constructed last year to work in the campaign of 1899. It was late in completion and some of the beets grown for it had to be shipped to other factories in the State, where they were purchased of the farmers. Experience with growing sugar beets for this factory last year was rather unusual. The factory is located on the lands of the Standard Cattle Company, which include some of the best bottom grain lands in eastern and northern Nebraska. In case of excessive rainfall these

lands, not having sufficient drainage, sometimes become flooded. This happened last year; all the beets planted for the factory received in the early part of the season entirely too much rainfall, and some of them were flooded. However, notwithstanding the heavy rain, ground that was not flooded for any considerable time produced a good crop of beets.

The experience of this factory for the next few years will be worth watching. As stated before, it is located on the lands of the Standard Cattle Company. This is one of the largest stock-feeding companies in the West, feeding both cattle and sheep. It has several thousand acres of land, upon which it grows the grain and hay for feeding the stock. This land is divided off into farms on which company houses are built for the laborers. These groups of houses have the appearance of little villages. The company has had considerable experience with growing sugar beets for the factories at Grand Island and Norfolk. It also grows extensively every year sugar beets for stock-feeding purposes. It has also experimented with feeding sugar-beet pulp, and it was largely through the results of this experiment that this particular plant was organized and a factory built. It was discovered that the pulp gave very desirable results in feeding, and as this company fed such large numbers of cattle and sheep the idea suggested itself that the two industries would not be a bad thing in combination. While the Standard Cattle Company and the Standard Beet Sugar Company are separate companies, yet the relationship existing between them is very close. I understand that practically the same parties are owners of both enterprises. Both companies have the same management in the person of Mr. R. M. Allen. Mr. Allen is president of the American Sugar Growers' Society. This cattle-feeding company is very careful in all its business affairs, and the public is bound to learn some very valuable information from its experience in feeding sugar-beet pulp on an extensive scale.

Heavy rainfalls came in August just at a time when moisture was least required. The result was that a great many of these beets were flooded. The Standard Cattle Company itself put in 2,000 acres of beets. The factory was late in starting on its campaign on account of being late in its completion. It started January 8. The Standard Cattle Company succeeded in harvesting about 1,625 acres of beets and placed most of these in silo to be worked last, working the farmers' beets first. The factory will require about 6,000 acres for the present year.

One of the noticeable things in connection with this plant is the remarkable rise in the price of farms occasioned by its location. This plant has a capacity for working 500 tons of beets daily.

NEW YORK.

Two factories have been established in New York, one at Rome and the other at Binghamton. The Binghamton factory completed its

second and the Rome factory its third campaign last year. In quite a number of places in New York the people have been seriously canvassing the question of starting factories. The conditions of the State have been thoroughly tested by Professor Roberts, director of the State experiment station, located at Ithaca. Many sections of the State have shown superior conditions for growing sugar beets. Owing to its many facilities for transportation and its proximity to the best market in the United States, the State has presented some very strong claims for the establishment of factories. As a State, it has the dairy and creamery interests pretty thoroughly developed and pretty evenly distributed throughout. The dairy feeders of New York State have made a very careful study for years of the value of feeding refuse of various kinds, so abundant in that State, coming from the factories, breweries, etc. Here is a State that at once appreciates the feeding value of pulp, and beet-sugar factories will from the beginning have a market for this by-product.

First New York Beet Sugar Company, Rome, N. Y.—This factory has a capacity for working 200 tons of beets daily. It closed its third campaign in 1899. It had a fairly successful year in the production of the crop, although it was not what would be called a full crop. The beets ran considerably higher in sugar content than in the previous year. The campaign closed the latter part of January, about 6,000 tons of beets having been sliced, from which was manufactured 550 tons of sugar.

Binghamton Beet Sugar Company, Binghamton, N. Y.—This factory has a capacity for working 350 tons of beets daily. It was the second factory started in the State, and closed its second campaign in 1899. The weather was rather dry for other crops in this section, but in the main the conditions were favorable for producing sugar beets, and the tonnage of beets secured from the same ground, as well as the sugar content, was higher than in 1898. The campaign lasted 45 days. From 3,000 acres of beets the factory received 14,881 tons, from which it manufactured 1,195 tons of sugar.

OREGON.

The chemist, Prof. G. W. Shaw, of the experiment station situated at Corvallis, Oreg., has been giving the possibilities of introducing the beet-sugar industry in that State considerable attention for the past seven years. He has shown conclusively, through a series of experiments, that there are several sections of the State well adapted for this purpose. The places yielding the most favorable indications and having the best conditions for producing sugar beets are eastern and southern Oregon, particularly Union, Umatilla, and Malheur counties, in the eastern part of the State, and Jackson County, in the southern part.

OREGON SUGAR COMPANY, LAGRANDE, OREG.—Among other sections of the State which showed good results throughout the experiments was the vicinity of Lagrande, Oreg., and at this place was located and constructed a factory with a daily capacity for working 350 tons of beets. It worked its second campaign last year (1899). Crop conditions were very fine in the vicinity of this factory, the fields running much higher in tonnage than in 1898, yielding about twice the amount of beets with a smaller total acreage. I am unable to give the actual results of the campaign.

MINNESOTA.

Experiments have been carried on all over the State of Minnesota, under the direction of the experiment station, in cooperation with the Department of Agriculture at Washington. These experiments have universally shown that the lower half of the State is capable of producing beets of good quality and purity, and that sufficient tonnage would be produced to warrant the farmers in growing the crop. The State of Minnesota has been rapidly developing the dairy industry, a movement which will be very much accelerated by the introduction of the sugar industry, affording as it does so many advantages to the stock interests in the use of beet pulp for feed. There has been considerable talk of locating other factories in the State, namely, at Albert Lea, Austin, and Mankato, and there is a strong probability that these places will eventually secure factories; still, it is not likely that any other factories will be in operation in the State until 1901.

MINNESOTA SUGAR COMPANY, ST. LOUIS PARK, MINN.—This factory is located in one of the suburbs of Minneapolis, the company securing the buildings and grounds of the old Wood's Harvesting Company. This factory closed its second campaign last year (1899). Its experience in the campaign of 1898 was not very favorable. It found difficulty in securing enough acreage to grow beets for that season. In fact, it only secured about one-third the amount of beets necessary to run its full campaign. Climatic conditions were not very favorable, and beet growing was entirely new to the farmers, but their success in growing the beets was sufficient to encourage them to grow the beets for the factory the past year.

Another trouble met with by the company grew out of the manner of constructing the factory itself. The factory was designed and arranged to fit into a factory building constructed for an entirely different purpose, and, from the beginning, this company met the troubles that result from trying to take an old building and fit it over for a sugar factory. It seems that wherever this attempt is made the results are generally very unsatisfactory. By repairing, altering, and rearranging it at considerable expense the success of the factory was much increased the past year; and by a more careful canvass among the farmers for acreage on which to grow sugar beets a much larger

supply was secured for the second year's run. This factory has a capacity for working 350 tons of beets daily. In order to avoid congestion in the yards in the delivery of the beets the company purchased a locomotive and does its own switching. It has also put down artesian wells and very much increased as well as improved its supply of water. The season for growing sugar beets was very fine in Minnesota. The area for growing the beets for this factory is quite large, the greater portion of the beets coming in by railroad, and some of them from a distance of 75 miles. The legislature passed the bounty law last winter and in it fixed the price of beets. The scale is $4.25 per ton for beets testing 12 to 15 per cent sugar, and an additional 25 cents for every 1 per cent over 15 per cent. The factory was able to dispose of the pulp as fast as it was produced, the price starting out at 22 cents per ton. The results of last year were so favorable to all concerned that both factory and farmer are looking forward to next year with considerable anticipation. At first this company found it a little difficult to secure contracts with the farmers to grow sufficient beets, but that time is now passed. The results of the last year have fully convinced the farmer that more profit can be made in Minnesota from growing sugar beets than from anything else produced on the farm, and he finds in addition that his land is very much improved by the superior cultivation imparted to the soil in growing sugar beets. He also finds that the sugar-beet pulp is affording him a great deal cheaper and better food ration for his dairy cow than he has been accustomed to. With his farm improved, his dairy cow improved, and his bank account improved, he is becoming a strong friend of the beet-sugar industry.

This factory worked 22,211 tons of beets this last year and manufactured 2,343 tons of sugar; the length of the campaign was one hundred and two days; the number of acres planted was 3,000, and the weight of sugar secured from the crude weight of the beets was equal to 10.54 per cent.

ILLINOIS.

Illinois was one of the States which engaged in the early attempts to start the beet-sugar industry nearly thirty-five years ago, the result of which attempts put a quietus on the industry until its subsequent revival in this country within the last twelve years. It appears that we had not at that time reached the condition where we could devote the necessary time, labor, and expense to install an industry entirely foreign to our previous experience. The process was too slow. Farming interests were not sufficiently organized, nor were the farmers as well educated on agricultural subjects, as careful readers of agricultural literature, or as methodical in the planning of the work of their farms. It was not necessary. New farms could be had of the Government by taking possession. The demand for crude material

was sufficient to meet the wants of the farmer during these earlier attempts to install the industry. Quick returns were the principal incentive to farming.

Illinois has been carrying on extensive experiments in cooperation with the Department of Agriculture at Washington for the past four or five years. These experiments were managed from the State experiment station, located at the State University, Urbana, Ill. These experiments have demonstrated that the greater portion of the northern half of Illinois is adapted to this industry. Beets of good quality and purity can be grown, and of sufficient tonnage to realize to the farmer a better profit than almost anything else grown on the farm. Illinois has been especially fortunate in the detailed way in which the experiments have been arranged. After the first year's experimentation, under the direction of the State experiment station, it was discovered that not sufficiently reliable data could be secured by an indiscriminate sending out of seed and growing of beets; that a better method would be to organize the State into sections and then plant the beets on larger plats, arranging that the plats in each section should be thoroughly supervised by a competent person during the planting, growing, and harvest seasons. In order to carry this out, a fund was raised sufficient to carry on this experimentation thoroughly. As a result very accurate data were secured as to tonnage, quality, and purity of beets grown in these different sections, and as a further result a factory was built at one of these points—Pekin, near Peoria, Ill. This factory has extended an offer to farmers in these different sections to take the crop from any tract of more than 5 acres upon the same terms that it offers the farmers in the immediate vicinity of Pekin. The difference in freight rates is the only thing that stands in the way, and associations of business men are being formed at various places, which offer to defray the extra freight charges in order to encourage the farmers to grow beets for the factory this year. Associations have been established at Elmwood, Gibson City, Bloomington, Springfield, Ottawa, Rockford, Rock Island, Galesburg, Decatur, and Quincy. The manager of the Pekin factory, Mr. Theodore Hapke, has had an extended experience, both in Germany and this country, and responds to calls all over Iowa, Illinois, and Minnesota, giving to farmers and organizations information concerning the benefits and needs of this industry.

Illinois Sugar Refining Company, Pekin, Ill.—This factory started up about the middle of October, 1899, had forty-five days' run in the campaign, secured 14,881 tons of beets, and produced 875 tons of sugar. The factory has a working capacity of 700 tons of beets daily. The climatic conditions were not very favorable for growing sugar beets in Illinois, as was the case in most other sections of the country. Of course the plant had to meet the usual discouraging results of depending upon farmers unacquainted with the culture of sugar beets

to grow the supply, and in order to secure the necessary acreage the company was compelled to lease land and cultivate more or less acreage of sugar beets itself. The results to the farmers were considerably above those usually found in places where sugar beets were grown for the first time. The results largely depended upon the cultivation and attention the individual farmer gave to the crop. As is usually the case, some farmers followed directions very closely and others gave very little heed. I saw quite a number of deliveries at the factory by farmers who were completing the delivery of their crop, which would average from 14 to 16 tons per acre. I saw others that would not run over 6 tons. The highest record I heard of while there was 21 tons per acre. The supply of beets was hardly sufficient to run the factory more than one-third of a normal campaign, but the outlook for this year is quite encouraging. Farmers are taking hold and contracting more readily. Other sections of the State are growing sugar beets for the factory in order to test their conditions, and, in addition, central Iowa will grow about 2,000 acres and ship them to the factory at Pekin. The purpose of this is to test the conditions for growing sugar beets in the neighborhood of Des Moines, where parties are anticipating the building of a factory.

WASHINGTON.

The people of Washington have given the sugar-beet industry considerable attention. Different sections of the State have been quite generally tested for conditions affecting the growth of sugar beets and the manufacture of sugar from them. It has been found that several localities are very well adapted for this industry, and as an outgrowth of the experiments carried on by the State experiment station, Pullman, Wash., in cooperation with the United States Department of Agriculture, a factory has been established at Waverly, in the northeastern part of the State.

WASHINGTON STATE SUGAR COMPANY, WAVERLY, WASH.—This factory has a capacity for working 350 tons of beets daily. The past year was not very favorable on account of many things. The factory was built hurriedly and the management did not have sufficient time to give to the crop of beets during the growing season. The farmers were entirely unacquainted with sugar-beet culture, and not enough oversight or intelligent direction was given the agricultural side of the work. However, the results of last year afforded both factory and farmers sufficient experience to more intelligently enter the field next year. A larger acreage will be contracted, and everything indicates that this year's results will be a great deal more favorable, and that the beet-sugar industry is thoroughly installed in the State of Washington, with the prospect that other factories will follow soon. I have not the details of the results of the past year's campaign.

COLORADO.

THE COLORADO SUGAR MANUFACTURING COMPANY, GRAND JUNCTION, COLO.—This is the first beet-sugar factory built in Colorado. It is located at Grand Junction, Mesa County, in the western part of the State. C. N. Cox, of that place, is general manager. The factory itself is very substantially built. Its present capacity is 350 tons of beets per day. The plant is constructed entirely of brick and steel, the framework being entirely of steel. It may be remarked here that one of the good indications appearing last year in the construction of factories was the substantial character of most of them, the frameworks being entirely of steel and put up prior to the construction of the outer walls of brick. The different sections of Colorado have been tested quite thoroughly by the State experiment station located at Fort Collins. These tests have covered a series of seven or eight years. The results have always shown that beets of superior quality could be grown in several sections of the State, among which were Greeley, Loveland, Eaton, Grand Junction, Arkansas Valley, and San Luis Valley. Quite a rivalry existed as to which should secure a factory first. Besides the tests made by the experiment station at Grand Junction, a business men's organization was effected for the purpose of growing the beets and thoroughly testing them in Grand Valley, from Glenwood Springs to Grand Junction. This organization was also for the purpose of promoting the industry. The securing of this factory at Grand Junction is the direct result of the work of this organization, and the success of the plant the past season has been largely due to two of the local men in this organization, Mr. Cox, the manager, and Mr. Mitchell, who was the agriculturist during the season of 1899, but who has since removed to Fremont, Ohio.

During the earlier part of the growing season the climatic conditions were fair for growing a good crop, the great drawback and the mistake being that so much new land was used to grow sugar beets. The experience of this factory is of sufficient importance to deserve special attention, as it illustrates an important point, namely, that an attempt should not be made to reclaim new and wild land by growing sugar beets upon it for factory purposes. The larger portion of the land selected for growing sugar beets this year was new. It broke up hard and could not be sufficiently pulverized and reduced for the purpose of growing sugar beets, neither had the elements an opportunity to favorably operate on this soil, affecting its condition for growing a good crop. The results were that wherever beets were grown on this new land the stand was poor, and the general results were bad. On the other hand, where the beets were planted on land that had been under cultivation for a sufficient length of time to reclaim it and make it eligible as good sugar-beet land, the crops were good and held up the reputation acquired by the valley in former experiments as being capable

of producing a good quality and sufficient quantity to sustain successfully the operation of a beet-sugar factory. This valley, with Grand Junction as a center, has earned a great reputation as a fruit section. This is one of the reasons why the factory was compelled to accept so much new ground, as the ground that had been already reclaimed was mostly employed growing fruit trees.

With people living in sections of country where new orchards of various kinds are being planted the problem has always been: What crop can be grown among the young trees, the cultivation of which will give the young orchard sufficient cultivation and not retard or injure the growing trees, but at the same time yield a profit? In a great many sections a man has to wait until his orchard has grown up and begins to produce before he can realize anything on his investment. The best crops of sugar beets that I saw at Grand Junction were those grown between these young trees. This was on account of the superior cultivation which the fruit grower gives these lands in order to produce a healthy orchard. By raising sugar beets the fruit grower not only has his orchard well cultivated, but he receives a good profit from the lands while the orchard is growing. The advisability of attempting to combine these industries in this way is, however, seriously questioned, as will be seen by the following statement prepared by Mr. Mitchell:

In regard to the growing of beets between tree rows, I regret to say that, owing to the hurry and confusion of a first season, I kept no special data. But while not able to confirm my statement by figures, I have no hesitancy in saying, "Do not encourage the planting of beets between tree rows." It is perfectly true that while the trees are yet very small the ground may be used between trees for beet raising, but it is much better for the orchard than it is for the beets. Of course if the beet crop is taken care of it insures cultivation of the ground, which is very beneficial to the trees. But there are many reasons why growing between tree rows is not a good plan as far as the beets are concerned. In an irrigated country the growers frequently do not use enough water for the beets for fear of injuring the trees. Eight rows of beets are about all that can generally be planted between trees, and this gives you one-fourth of your crop outside rows; and the beets in these outside rows are very apt to be large and coarse and apparently unable to store the proper amount of sugar.

Again, when it comes to harvesting the crop, it is frequently found that if a plow is used for digging it cuts so deep as to injure the tree roots; or, if a surface puller is used and run close to the trees, the horses or tools are apt to bark and scrape the trees.

The old saying, "A man can not serve two masters," applies pretty well to raising beets between tree rows. Either the beets are sacrificed to the trees, or vice versa. I am emphatically opposed, from personal experience, to raising beets between tree rows. In a fruit country the orchard will pay well enough of itself, and, in justice to a beet crop, it should be given ground to itself and get all there is out of it, not only in care and attention, but in plant food.

This company also had the usual experience of new companies in not being able to impress upon the farmers the necessity for the labor and attention required in cultivating their beet crop. Labor was hard to secure. This factory is trying to get a thousand families to come in

from different sections of the country and go into the business of growing sugar beets, holding out the following inducement: The sugar company will give free use of land and water to colonists for five years, with the option to buy the land at moderate price, payments to be made in beets. It is believed that under this inducement the valley will have sufficient labor to grow the beets, as the inducement will be sufficient to pay the farmer for reclaiming the land.

MICHIGAN.

In recent years Michigan has been among the foremost of the States agitating this question. Probably no State in the Union has given more attention to scientific experimentation in order to arrive at a correct understanding of the conditions in the State. The State experiment station at Lansing conducted experiments all over the State, sending out seeds and information as to the best methods of planting, cultivating, and harvesting. At the close of the season the station systematically analyzed specimen beets from each farmer's plat, ascertaining the sugar content and purity of the beets grown in the various sections. The experiment station has covered an enormous amount of work of this kind and published the results, so that the public might be generally advised as to the condition of the State of Michigan in all its various sections for growing sugar beets, and also the conditions that obtain in the State for manufacturing them into sugar.

These conditions are peculiarly favorable for several reasons: The State has an intelligent, active farming community; the soils appear adapted to growing sugar beets; the sugar content and purity of the beets ran very high throughout the experiments of several years. Michigan has an abundant supply of cheap fuel in her coal deposits; a good quality of limestone is easily accessible; large market centers are near, which will make a sure demand for the product; there are competing railroads, with probably as low freight tariffs as are enjoyed by any section of the country. In addition to this there is water transportation to some of the large trade centers, such as Chicago, Milwaukee, and Detroit.

In addition to these numerous positive inducements to engage in the sugar industry in the State of Michigan, there was another, an incidental inducement, which probably exerted as much influence in this direction as any of the rest, and that was the waning of the lumber industry of Michigan. The State once sustained a large industry in the production of lumber of all kinds, but for a decade the sawmills of Michigan have been curtailing their business or closing down on account of the diminishing supplies from the forests. In the last few years it has become a fact patent to everyone that the lumber industry of Michigan is fast coming to an end. This would leave a great deal of organized capital out of employment. The capitalists have been looking for

some new industry which they could introduce into the State to fill the void. They were ready to extend to the sugar industry a welcoming hand.

The first factory to start was that of the Michigan Sugar Company at Bay City. This organization was induced largely by the results of experiments carried on by a temporary organization at Saginaw.

The experience of this factory during the fall campaign of 1898 induced the building of eight more factories in the State in time for the campaign of 1899. It seems probable that Michigan will have still others ready for the campaign of 1900. The factories built last year were those of the Bay City Sugar Company, Bay City; the Detroit Sugar Company, Rochester; the Wolverine Sugar Company, Benton Harbor; the Peninsular Sugar Company, Caro; the West Bay City Sugar Company, West Bay City; the Alma Sugar Company, Alma; the Holland Sugar Company, Holland; the Kalamazoo Sugar Company, Kalamazoo.

The nine sugar factories of Michigan started up, some of them being a little late, but all of them in time, to work up the crop of beets grown. The results for the eight new factories were somewhat varied as to the degree of success attending the first year's operations. Some of these enterprises had been hurriedly organized and were late in beginning their construction, late in completing the same, and late in beginning their campaigns in the fall. Like all other new companies, they were compelled to accept whatever land was offered for growing the beets, and then in the fall were compelled to accept almost any kind of beets offered, because the supply was small. Some of these plants actually ran through the year without having anyone about the concern possessing any practical information about growing beets or getting them ready for the factory. They simply relied on what information could be gotten out of printed matter or conversation with those posted in some degree, and in this way their supply of beets for the first year's run was procured. As said before, this was largely due to the hurried manner in which the organizations were effected, capital raised, and factories built. This kind of work necessarily furnishes a great deal of costly but valuable experience. These factories next year will be in a position to give much more attention to the agricultural side of the business. Farmers will be able to grow beets a great deal cheaper and very much better, and a better class of land will be called into requisition for growing the beets than was used in most places last year.

There are two legitimate criticisms that can be made on the growing of beets in Michigan in 1899. I examined a great many beet fields at nearly all the different factories in Michigan. There seemed to be a tendency to use the poorer quality of land instead of the best for growing sugar beets. It seems to be a common error in the minds of farmers who have not had experience in growing sugar beets that sandy ground must be selected for this purpose, and that regardless of whether it

possesses any fertility or not. This error is given out in newspapers, public talks, and lectures, mostly by persons who have not had practical experience. This probably comes from the fact that, with most people in the Mississippi Valley, knowledge of sugar-beet growing for factory use began in Nebraska at Grand Island and Norfolk, where all the soils in the vicinity are quite sandy. Much of the information that has been disseminated through the States east of Nebraska came through the experience of growing sugar beets in that State. But those interested in the industry in Nebraska have long since learned that they must call into requisition their very best soils, and that there are soils in other sections which are much superior to those on which sugar beets are grown about Grand Island and Norfolk. Barring black muck or waxy soils, the kind of soil that would be selected to grow a good crop of corn or potatoes is the kind that should be selected to grow a good crop of sugar beets. Of course, sufficient sand to prevent the soil from becoming hard and compact will help, but the fertility must be there. The soils in the State of Michigan, where the beets were grown last year for the factories, have been in use for some time and are pretty well exhausted. In introducing this new crop the State of Michigan will have to put into the business of growing sugar beets the very best soils she has, and in addition thereto she will have to resort more or less to a systematic course of fertilizing and rotation of crops. Another suggestion I would make in this connection is that the beets be planted in wider rows and farther apart in the row on these weaker soils than was done last year.

It can not be said that the experience of the sugar-beet growers in Michigan last year was as a rule encouraging, but I think the experience of this year will be much more favorable. Climatic conditions were very bad last year; an excess of rain fell at a time when it was not needed, and the weather was excessively dry at a time when beets needed moisture most. It would be hard to select a year more unfavorable than last year in Michigan for growing sugar beets. In addition to this it was precipitating a heavy task on the farmers of Michigan to ask them to grow at once and for the first time sugar beets sufficient to keep in operation nine sugar factories during a campaign, and that in a section of country where practically nothing was known about the art of growing sugar beets and where no organization had been effected to discover a class of labor educated and available for this purpose, so that practically the whole crop was produced by inexperienced and unprepared labor. I saw a field of 16 acres of sugar beets that had been nicely cultivated and kept clean and looked from the road to be in splendid shape. But on going into the field it was discovered that the field of beets had never been thinned. On talking with the farmer I found that no attempt had been made to thin them, as he did not believe it was necessary. The largest of these beets would probably weigh three-quarters of a pound, and they ranged from that down to

the size of radishes. Here was a whole field of beets that would have given a beautiful stand if they had been thinned. It had been carefully cultivated and was free from weeds, but it was an absolute failure as a crop. The importance of thinning was not appreciated as a rule in Michigan. There was a tendency to leave beets in bunches and this was enough to affect the whole amount of the crop seriously. The best and most careful attention given to the growth of the sugar beets was at the Caro factory, and here I found the best beets grown in the State of Michigan during the season, probably as good as could be grown under the circumstances, considering the weather and the fact that this was the first year for the soil and farmers in growing sugar beets. The success of this factory was due entirely, I think, to the selection of a capable and industrious farm superintendent who had had extensive experience in growing sugar beets, both in Germany and in the United States. I at one time examined his farm in Nebraska, where as a farmer he was growing 300 acres of sugar beets for the Grand Island factory.

All in all, the year has given the Michigan farmers and factory managers a great deal of experience, and consequently better results may be looked for in that State in 1900. I am confident that the sugar industry of Michigan has come to stay. The farmer is learning his part, and with this and last year's experience, will be able to furnish the factory with sufficient quality and quantity of beets, and with profit to himself. The stock raiser and dairyman will discover that a great impetus has been given their industries by this sudden introduction of large quantities of desirable and valuable yet cheap stock food in the sugar-beet pulp. I predict that this feature alone, when the benefits accruing to the agricultural interests of Michigan shall have been determined, will make a showing that will surprise the State. It will make it possible for Michigan to go into animal industries on a large scale, feeding beet pulp along with grain, and establishing dairies to produce milk, butter, and cheese for the near-by market centers. The State of Michigan during the last factory campaign produced 30,106,113 pounds, or 15,053 tons, of sugar, made from 210,911 tons of beets, which yielded in addition 105,455 tons of pulp.

Taking up the individual factories in the State of Michigan, the following can be said of their experience last year:

THE WOLVERINE SUGAR COMPANY, BENTON HARBOR, MICH.—This company started out with about 4,100 acres contracted for growing sugar beets, the factory having a capacity for working 350 tons of beets per day. Heavy, cold winds, beginning with the early planting, completely killed a large acreage and more or less damaged all. Large areas planted in sugar beets were entirely covered by water. Agents of the factory were sent out, and succeeded in getting much of the acreage replanted, but the entire area was reduced to about 3,000 acres. The factory succeeded in beginning operation about the 1st of

November, and closed January 7, producing 880½ tons of sugar from 12,105 tons of beets.

HOLLAND SUGAR COMPANY, HOLLAND, MICH.—This factory, having a capacity of 400 tons of beets daily, started out with about the same experience as that of the factory at Benton Harbor, the first planting being affected by the excessive cold rains. Replanting was resorted to in most instances, but the total acreage of growing beets was materially reduced. The factory began operation about the middle of November, worked 18,000 tons of beets, and produced 1,292 tons of sugar.

KALAMAZOO SUGAR COMPANY, KALAMAZOO, MICH.—The climatic conditions for growing sugar beets for this factory were fairly good, better than those at Holland and Benton Harbor. A feature introduced by this factory was the attempt made to secure someone who would try the experiment of making paper out of the sugar-beet pulp, and it will be interesting to learn the result of this effort.

This factory has a capacity for working 500 tons of beets daily. It put out its first package of sugar December 1, and manufactured during the campaign 720 tons from 10,713 tons of beets. The factory was early in the field to secure acreage for growing beets for the next campaign, and will extend the area considerably. The company contracts to pay the farmers $4.50 per ton for beets testing 12 per cent sugar, and 33⅓ cents additional per ton for beets showing an additional 1 per cent of sugar. This is an increase of 50 cents a ton over the price paid last year. It will be the endeavor to secure an acreage of at least 5,000 acres.

MICHIGAN SUGAR COMPANY, BAY CITY, MICH.—This was the first beet-sugar plant started in the State of Michigan. It was built and equipped ready for the campaign of 1898, beginning late in the fall. Its experience during the first year brought to light some mistakes in construction and in methods of growing beets, but on the whole the result of the first year's campaign was sufficient to enthuse the capitalists and farmers of the State to the point of starting eight new plants to work up the crop of 1899. The first year it worked up 35,187 tons of beets. These beets were grown in 18 different counties, and they produced 3,000 tons of granulated sugar. The farmers received for these beets $150,000. The encouragement was sufficient to induce the farmers to continue growing beets. The campaign made apparent several weak spots in the construction and arrangement of the factory, which made necessary a rearrangement at considerable expense, after which it was able to cope with the business more successfully during the campaign of 1899. The Beet Sugar Gazette of Chicago gives an estimate of the cost and value of one acre of sugar beets grown for this factory for 1898, showing pretty good results for the first year's experience and on ground growing sugar beets for the first time. It shows

good profits, even after the payment of freight and other expenses not usually paid. The following is the statement:

John Ortner, of Gera, Mich., got pay for one acre of sugar beets raised by him for the Michigan Sugar Company and the following shows there is money in it: 40,789 pounds of beets at $4.66\frac{2}{3}$ per ton, tested 14 per cent, amounting to $95.17; deduct for unloading, $1.79; freight, $6.85; seed for two acres, $5.40; total expense, $14.14, which taken from the amount received, leaves $81.03. The total paid out for labor and rental value of land equals $35, which leaves a net profit of $46.03 per acre. George Ortner's sugar beets raised on heavy clay land tested 15 per cent, netting him $35 per acre.

Through the experience gained in 1898 farmers were able to produce beets a great deal better in 1899, although the climatic conditions were not so favorable. The factory closed its campaign about the middle of February, having sliced 43,127 tons of beets and manufactured 3,524½ tons of sugar, its capacity being 400 tons of beets per day.

West Bay City Sugar Company, West Bay City, Mich.—This plant was established in West Bay City, largely as a result of the Michigan sugar company's success. It has a capacity of 500 tons of beets daily. In growing the beets for the campaign just closed it had the benefit of the experience of the farmers who grew beets for the Bay City factory in 1898. It is estimated that this factory worked up 12,556 tons of beets.

Bay City Sugar Company, Bay City, Mich.—This company is also the outgrowth of the success of the Michigan Sugar Company in 1898. The factory is situated near that of the former. This makes three beet-sugar plants in this one locality, all calling upon the farmers for a supply of beets, scattering considerable money throughout that immediate vicinity, and the effects upon the town itself are very noticeable. These factories are doing much to compensate the city for its loss of lumber mills, this being formerly one of the centers for manufacturing lumber. This factory was in operation 110 days. It originally planted 6,000 acres of beets. It received and worked 41,454 tons of beets. Farmers received an average of $4.46 a ton for their beets. It manufactured about 3,044 tons of sugar, having a capacity for working 600 tons of beets per day.

Alma Sugar Company, Alma, Mich.—This factory, designed and constructed much after the pattern set by the Bay City Sugar Company, has a capacity for working 500 tons of beets per day. It was not successful in getting as large acreage as desired, nor was the weather favorable. It secured about 21,497 tons of beets and manufactured about 1,634 tons of sugar, closing the campaign January 16.

Peninsular Sugar Refining Company, Caro, Mich.—The crop conditions were much better in the sections where beets were grown for this factory than those prevailing in other sections. One thing that can be said is that the farmers grew the beets much more advisedly than did those who grew beets for some of the other new factories.

This concern kept thoroughly experienced and trained beet raisers in the field instructing the farmers as to the best methods of growing the beets. The capacity of this factory is 600 tons of beets per day. It worked 27,928 tons of beets and manufactured from them 2,020½ tons of sugar.

DETROIT SUGAR COMPANY, ROCHESTER, MICH.—This plant, situated at Rochester, was organized by Detroit capitalists. Owing to the unfavorable crop conditions the beets averaged about 8 tons per acre. The factory was compelled, on account of emergencies of one kind or another, to close down two or three times during the campaign. Its supply of beets was 23,772 tons. Its sugar output was 1,835 tons. The factory began its campaign about October 2, and kept up very closely to its average capacity, which is 500 tons of beets per day. The beets averaged a little over 13 per cent of sugar.

SUMMARY OF THE STATUS AND PROSPECTS OF THE INDUSTRY.

I have here brought together the facts and figures which show in brief space the progress already made in the development of the beet-sugar industry and the prospects for futher developments in the near future.

FACTORIES IN OPERATION.

The following is a list of the companies operating in the United States with their present daily capacity in tons of beets:

	Tons.
Alameda Sugar Company, Alvarado, Cal	800
Spreckels Sugar Company, Watsonville, Cal., formerly Western Beet Sugar Company	1,000
American Beet Sugar Company, formerly Chino Valley Beet Sugar Company, Chino, Cal	750
Los Alamitos Sugar Company, Los Alamitos, Cal	700
California Beet Sugar and Refining Company, Crockett, Cal. (also refines Hawaiian sugar)	500
Oregon Sugar Company, Lagrande, Oreg	350
Utah Sugar Company, Lehi, Utah:	
Main factory, at Lehi 500	850
Slicing station, at Springville 350	
Ogden Sugar Company, Ogden, Utah	500
Pecos Valley Beet Sugar Company, Eddy, N. Mex	200
American Beet Sugar Company, Grand Island, Nebr., formerly Oxnard Beet Sugar Company	350
American Beet Sugar Company, Norfolk, Nebr., formerly Norfolk Beet Sugar Company	350
Minnesota Sugar Company, St. Louis Park, Minn	400
Michigan Sugar Company, Bay City, Mich	350
First New York Beet Sugar Company, Rome, N. Y	200
Binghamton Beet Sugar Company, Binghamton, N. Y	350
Spreckels Sugar Company, Spreckels, Cal	3,000
American Beet Sugar Company, Oxnard, Cal., formerly Pacific Sugar Company	2,000

	Tons.
Union Sugar Company, Santa Maria, Cal	500
Washington State Sugar Company, Spokane, Wash	350
Colorado Sugar Manufacturing Company, Grand Junction, Colo	350
Standard Beet Sugar Company, Ames, Nebr	500
Illinois Sugar Company, Pekin, Ill	700
Bay City Sugar Company, Bay City, Mich	600
West Bay City Sugar Company, West Bay City, Mich	500
Peninsular Sugar Company, Caro, Mich	600
Detroit Sugar Company, Rochester, Mich	500
Alma Sugar Company, Alma, Mich	500
Kalamazoo Beet Sugar Company, Kalamazoo, Mich	500
Wolverine Sugar Company, Benton Harbor, Mich	500
Holland Sugar Company, Holland, Mich	350
Total capacity	19,100

FACTORIES BUILDING.

The following is a list of the companies now building factories in the United States, with the location and capacity of each factory. Most of them will take part in the compaign of 1900. One or two will not be operated until 1901.

	Tons.
American Beet Sugar Company, Rocky Ford, Colo	1,000
National Beet Sugar Company, Sugar City, Colo	500
Continental Sugar Company, Fremont, Ohio	400
Empire State Sugar Company, Lyons, N. Y	500
Utah Sugar Company, Binghamton Junction, Utah (auxiliary to Lehi)	350
Marine Sugar Company, Marine City, Mich	350
Total capacity new factories	3,100

PROPOSED FACTORIES.

Under this head attention is called to beet-sugar companies already organized and which give every indication at this time of constructing their factories and having them ready for the campaign of 1900 or 1901.

THE FORT DODGE BEET SUGAR COMPANY, FORT DODGE, IOWA.—Articles of incorporation have been filed. Capital, $450,000; O. M. Oleson, president; W. T. Chantland, secretary. Most of the acreage desired by the company has been pledged by the farmers.

THE STORM LAKE BEET SUGAR DEVELOPING COMPANY, STORM LAKE, IOWA.—This company has recently closed contracts for the total amount of acreage necessary for a factory at that place for the campaign of 1901. It was claimed that the factory was assured provided sufficient contracts could be secured to grow the beets. These contracts are now all signed, and Storm Lake will probably be the first to start in the beet-sugar industry in Iowa.

THE FARMERS' COOPERATIVE BEET SUGAR COMPANY, DUNDEE, MICH.—This company has decided to build a factory this year, and will begin early in the fall so as to have the plant completed by July 1, 1901. It is proposed to build a factory of 750 tons daily capacity.

VIRGINIA BEET SUGAR COMPANY, FREDERICKSBURG, VA.—This company has perfected plans for building a factory at the above place, either to commence work in the campaign of 1900 or 1901, depending upon circumstances. This project at this time seems quite likely to materialize.

THE NORTHWEST BEET SUGAR COMPANY, NORTH JUDSON, IND.—It appears that a company was organized to operate a beet-sugar factory at the above place under the name of the New England Beet Sugar Company. This company contracted with the farmers for about 6,000 acres of beets, but for some reason failed to perfect its plans, and the Northwest Beet Sugar Company was organized for the purpose of carrying out these contracts and for operating a sugar factory at that place.

CONSUMPTION OF SUGAR IN THE UNITED STATES IN 1899.

The following is clipped from the Sugar Trade Journal:

The consumption of sugar in the United States for 1899 was 2,094,610 tons, against 2,002,902 tons in 1898, an increase of 91,708 tons, or 4.57 per cent. The consumption of 1899 consisted of 160,400 tons of domestic cane sugar, 79,368 tons of domestic beet sugar, and 5,000 tons maple and other sugars, a total domestic production of 249,968 tons; and 1,560,764 tons of foreign cane sugar, 272,943 of foreign raw beet sugar, and 5,935 tons of foreign refined, a total of 1,839,642 tons imported. * * * The amount of refined sugar which went into consumption in 1899 was 2,040,676 tons, of which the American Sugar Refining Company manufactured 1,385,608 tons, or 67.9 per cent; the independent refiners, 585,765 tons, or 28.7 per cent; the beet-sugar manufacturers who make refined sugar, 63,368 tons, or 3.1 per cent, and the foreign refiners, 5,935 tons, or 0.3 per cent. The amount consumed in the raw plantation condition was 53,934 tons. The undistributed stock of refined sugar we estimate at 20,000 tons, against 25,000 tons during last year.

GENERAL INFORMATION REGARDING CULTURE OF SUGAR BEETS.

The matter appearing under this general heading is reprinted, with slight revision, from my report for 1898, and is inserted here because of the great demand for plain, practical directions regarding sugar-beet culture.

CONDITIONS REQUISITE FOR GROWING SUGAR BEETS.

A great deal has been said in farmers' conventions and institutes, in books and periodicals, about sugar beets. The nature of the plant, its botany, chemistry, and insect enemies, as well as the theoretical, practical, and scientific phases of the business, have been discussed. As with a great many other subjects of this kind, before an experience and an acquaintance with the subject is obtained—that is to say, before practical details have been learned by the people generally—we have advocates representing all shades of opinion, good, bad, and indifferent. These views are deduced from studying the results obtained in European countries in which results and experiences differ on account of the different conditions that prevail. Propositions based on European experiences are jumbled together and offered to the American people interested in the industry of raising sugar beets as the principles governing the status of that vegetable in this country. It is safe to say that hardly any of these propositions is more than partially true. We have agricultural conditions of our own differing from those of other countries. We have agricultural methods of our own which are superior to those of any other country. So, as we acquire more experience, we are establishing facts and building up a science of our own touching the growing of sugar beets of good quality and purity under our own peculiar conditions. There are some general conditions, however, that vitally affect the quantity, quality, and, in fact, the life history of the beet. These may be considered under the following heads: Nature of the soil, moisture, temperature, and light.

NATURE OF THE SOIL.

In this connection the soil should be studied from the standpoint of structure and physical condition and available fertility. The soil for sugar beets should be naturally of friable kind—such as sandy loams, clay loams with sand, and soils which

permit easily of cultivation and penetration. It must be especially remembered that hard, impenetrable subsoils are not desirable. Hardpan is out of the question. The subsoil is of as much importance as the top soil, if not more. In the first place the sugar beet should embed itself completely in the soil. In the next place the tap roots should go down deep into the subsoil. In a general way it may be stated that a soil is desirable that is opposite in character to the hard clay soils and mucky, waxy soils.

On this question of soils, much misapprehension seems to prevail. The opinion seems to be very general that sugar beets demand a sandy soil, and this fact has led to much of the trouble which has arisen in Michigan and other places. This idea has done a great deal also to vitiate the results of the experiments that have been carried on throughout the various States. The misapprehension, as already stated, probably grew out of the fact that the soils where sugar beets are grown in Nebraska are quite sandy. This is true as to the sections where both of the factories are located. The fact is that the soils there are too sandy for successful sugar-beet growing. It should be set down as a governing principle that the best and most fertile soils available are the kind to use for sugar beets. The soil that would naturally be selected with the expectation of raising a big crop of corn or of potatoes is the kind to select for sugar beets, giving heed to the physical conditions mentioned above.

A soil may be fertile and yet lack some element which is necessary to make this fertility available. The choice of proper commercial fertilizers depends on the particular soil in question. A proper study must be given to the soil in order to render it of the best service in producing a crop of sugar beets. It is only fair to add that our soils generally do a great deal for sugar beets from their natural fertility.

MOISTURE.

By investigation among practical sugar-beet growers concerning the amount of moisture desirable for growing sugar beets I have learned that sugar beets will stand more moisture and get along with less of it than almost any other field crop. Although this statement is technically true, it must be taken with the following explanation: The sugar-beet plant at its beginning is one of the most delicate among the field crops. Wheat, corn, or almost any of the cereals sown in a dry time will wait for moisture, and when it comes will germinate and start off apparently not so much affected on account of this period of drought. It is not so with the sugar beet. It is likely to dry out, and the germ is liable to be killed if anything like this happens. It is also in jeopardy if planted during or just before a period of continued damp, cold weather. The necessary condition is that the best seed should have sufficient moisture and sufficient warmth to germinate it and start it. After it has become a plant of three or four leaves it is ready to cope with the other field crops in standing excesses of different kinds. During the next two or three months excess of moisture does not affect it seriously; it will grow and develop. At the close of this period of growth the beet is said to have matured as to its form and size. The next thing that is necessary is an elaboration of the sugar in the beet. Through August, September, and October the least moisture possible is the thing to be desired for the sugar beet. Here comes in the application of the statement that it will get along with less moisture than any other crop.

After having about attained the size desirable the beet needs the cooperation of various influences in order that the sugar may be produced in it. Moisture is not one of these influences. Just here arises one of the difficulties in the raising of sugar beets in States that have fall rains, such rains as produce fall pastures, and are quite desirable in many respects to the agriculturist, but which would be regarded by the sugar-beet grower with dismay. What we need during this period, and especially in September, is plenty of light and weather which is rather cool and dry. Late rains or irrigation result always in second growth. The beets send out laterals from the

roots and new leaves. These leaves are produced at the expense of the carbohydrates or sugar, whose formation we are trying to promote in the beet, the elaboration of the sugar content of the beet stops, and the sugar already formed may be called for in this work of forming new leaves. Now, if we should add to such an unfortunate moisture condition a warm temperature this growth of leaves and roots will only be accelerated. Thus it can be readily seen that fall rains are not desirable.

Briefly recapitulating, the three periods for the development of the sugar beet are as follows:

The first, which might be called the germinating and plantlet period, from the beginning of planting up to the time when the plant attains, say, four leaves.

The second is the growing period, in which we establish the form and size of the beet.

The third is the period of sugar elaboration which runs up to and includes the harvesting of the crop.

In the Mississippi Valley and the northern section of the country generally the first period would be from the 1st of April to June; the second period from June to the close of August; and the third from the last of August to the 1st of November, these periods all overlapping.

TEMPERATURE.

It is desirable that, at the time of germinating, the soil should not only be moist, but warm. The temperature that is desirable after that it is claimed is one that has an average of about 70° during the growing of the beets, or second period. I believe an even temperature is quite desirable in order to produce the best condition for the beets, and yet I can not help thinking from the results that have been obtained in some sections that too much stress has been put upon this matter of temperature. I think this subject has been discussed too much from the standpoint of results obtained in other countries. When we shall have established facts of our own with reference to this point it may be found that there are localities in the South in which sugar beets can be grown successfully, and factories may be established in those localities to manufacture sugar from beets grown there. Temperature is only one of the conditions, and it may be demonstrated that other favorable influences can counteract the effect of too high temperature.

LIGHT.

Beets and other plants have organs which perform a work corresponding to that done by the lungs in animals. These organs in the beets are situated in the leaves on the under side. The idea will therefore suggest itself that beets which have larger leaves, well spread out, have a better opportunity for working on the air, and therefore a better opportunity for producing the sugar in the beet. Air and light are essential factors in satisfactory plant growth, and especially necessary to the formation of sugar. Hence this stage is greatly accelerated by the action of light and unobstructed sunshine. This explains the necessity for long, cloudless, bright days during the period of sugar elaboration, which constitutes the last period in the life history of the sugar beet; also the desirability of a complete absence of noxious weeds and other foreign material which may interfere with the free access of light and air to the leaves of the beet.

General Suggestions for Raising Sugar Beets.

Long experience in the cultivation of sugar beets has furnished certain rules which are general in their application and which govern the preparation of the soil, seeding, thinning, and cultivating the beet plants. Some general requirements are here given, and some others that have local application are suggested. Reasons for the requirements or rules are also given in some instances.

PREPARING THE GROUND.

In order to produce a beet of right form and pure throughout, the soil must be such as will permit the beet to penetrate it readily with its taproot, and also permit it to embed itself wholly therein. If this is not the case, the tendency of the beet is to "sprangle" out, which it should not do. It should have a single taproot, which tapers off into a long, thread-like appendage, striking down deep into the subsoil.

The beet should grow under the soil as much as possible, and the top portion should not stick out above the surface, as this is not only deleterious to the whole beet, but makes it necessary to cut off that portion which projects above the ground before the beet is sent to the factory, causing that much loss to the grower.

The soil should usually be plowed about 8 inches deep, the plow being followed by a subsoiler that loosens up the earth to the extent of 7 inches more. Then it should be harrowed back and forth until it becomes thoroughly pulverized and softened. This condition is necessary to germinate the seed and assure ourselves of a stand of beets. If seeds are sown in ground where the surface is lumpy and cloddy, even if the lumps are quite small, the effect is bad. The seeds are sown from a half inch to an inch in depth. The beet seeds, having a rough, dry husk, with convolutions on the exterior, must be planted in a soil that is soft, so that it will press against the sides of the seeds, filling up the little depressions, thus inducing capillary attraction to bring the moisture from the soil to be absorbed by the seed, causing germination. On the other hand, small clods are likely to keep open little channels around the seed through which the dry air circulates and dries out the seed so that it finally dies. Thus the opportunity for securing a good stand is diminished, as well as the chance of securing strong and healthy plants at the outset, all of which emphasizes the importance of a highly pulverized soil.

It is usually the practice in stirring up the ground preparatory to planting sugar-beet seed to do the first plowing in the fall. The subsoiling is also done at this time. In the colder regions we thus have the benefit of freezing and thawing, which crumble and pulverize the soil, as most farmers are aware. In the spring the ground is plowed again with a shallow, stirring plow or a good cultivator, and this is followed by harrowing, etc., to prepare the surface.

In the sugar-beet districts of California it is the rule for the farmers to do the larger part of their cultivating in the early spring. In fact they aim to kill all the weeds they would otherwise have to contend against before the beet seeds are planted. The conditions there are more advantageous for this purpose than in most other sections, because the winter rains and early warmth cause the grass and weed seed to germinate so that when the ground is cultivated the weeds are killed. A second crop of weeds is then allowed to start, and the ground is cross cultivated to kill them. This also helps to get the soil in condition for planting. After planting there are no further rains, and consequently no such opportunities for weeds to grow as there are in States where it frequently rains. I have, however, found sugar-beet growers following this method of killing weeds to some extent and with good effect in the Mississippi Valley, where weeds grow luxuriantly during the growing season of the beets.

PLANTING.

Special implements or drills are used for the purpose of sowing sugar-beet seed. Some of these implements have special arrangements for sowing the seeds in ridges and others for planting them on level ground, the latter being more usually the custom in this country. Where seed is to be sown on a large scale it is preferable, at least more economical of time, to use the four-row seeder, which can be regulated with much precision for sowing a definite number of pounds of seed to the acre. The best practice in this country appears to be to sow from 15 to 20 pounds per acre, with a leaning toward the latter amount. It is better to be a little out of pocket on account of seed wasted than a good deal out on the quantity of beets grown owing to a poor stand.

PLANTING AND CULTIVATING IMPLEMENTS.

The companies that make a specialty of implements for the cultivation of sugar beets have what they call a "full set of tools." In cases where the four-row seeder is used, a four-row cultivator is a part of the set. This is desirable from the fact that the cultivator follows the same four rows and in the same order that the seeder planted them, so that if there is any variation from a straight line the same variation will occur in each of the four rows. The person who is holding the cultivator handles has only to watch one row, and if it becomes necessary to shift the implement to one side or the other on account of a variation in that row, the same will be true of the other three rows. The implement companies have also a set of two-row implements that operate in the same way. The cultivators used in this country are usually drawn by one horse or mule. Most of those who have had experience with both animals prefer the mule for this purpose. It is claimed that the mule is more compact in proportion to his power, and, having smaller feet, when the width between the rows is narrow—say 14 inches—he is not so liable to injure the beet plants. It is also claimed that the mule is more susceptible to training in this particular line of work, especially in following the rows faithfully. He needs less attention from the person holding the handles of the cultivator, who thus has more time to devote to cultivation. This one mule or horse is all that is needed to pull the cultivator, taking four rows at a time. After the seeds are planted it is usual to roll the ground, and by this means compress the soft dirt thoroughly around the shell of the beet seed, as has been suggested. This practice serves well to accomplish this purpose, but in some localities it is found to be undesirable to retain this smoothly rolled surface, and to prevent evaporation it is "roughened up" by the use of a harrow. This is done, where the soil is quite sandy and the prevailing winds are very strong, in the spring, because where the ground is very level the wind carries along with it over the smoothly rolled surface small, sharp particles of sand, which strike the sugar beet plants, often cutting them off even with the surface.

The first cultivation is accomplished with small plows or knives attached to the cultivator, called "goose feet," because they resemble very much the form, shape, and size of a goose's feet. The edge of the knife runs within 1½ to 2 inches of the beet, a knife running on each side of the beet plants in each of the four rows, the side next to the beet presenting a square surface. The cutting part of the foot runs from one-half to an inch below the surface and parallel with it. It is not the intention to stir the soil to any depth, but simply to run the knives under the surface for the purpose of cutting off the roots of the weeds and grasses and breaking up the crust of the soil. This is the usual practice in the early stages of cultivation. Later it is usual to replace the "goose feet" knives with "bull tongue" cultivator blades, so named from their similarity in form to a tongue. These cultivate down 3 to 6 inches.

THINNING AND BUNCHING.

It is customary as soon as the beet plants get through the ground so that the rows can be readily discerned to go over the field once with the cultivator, with the "goose-feet" knives attached. This catches the first weeds in their early stages, breaks up the hard surface, and permits bunching and thinning to better advantage. Bunching is resorted to to save time and labor. A person goes along the rows and with a sharp hoe cuts out most of the surplus plants in the row, leaving the plants in bunches from 6 to 10 inches apart, as may be desired. He is followed by another who does the thinning. He crawls along the rows on his hands and knees, and selecting the most thrifty plant in a bunch, takes it between the first two fingers, with the back of the hand toward the ground, then with a quick movement of the fingers of the other hand, he grasps the surplus plants and removes them from the soil. This is one of the most laborious features of sugar-beet raising. It can be done by boys and girls from 12 to 16 years old, who are very active in the work. In fact, this kind of labor can be used to a great extent all through the various stages of cultivation

of the beet. I have known farmers in their earlier experience with raising sugar beets who looked upon this thinning out as a great waste of seed, and who tried the experiment of planting less seed next year. This experiment usually ended in disaster, especially if the conditions for germinating the seed happened to be unfavorable. It is not often that a farmer repeats this experiment.

TIME FOR THINNING.

It is a very serious mistake to allow the plants to become too large before they are thinned. The "agriculturists" at the different factories are particular on this point when scanning the work of the farmers who are growing beets for the factories. There is a tendency of the plants where they are grown close together to twine around one another, and the principle to be observed in thinning beets is to remove the surplus plants in such a manner as to leave the plant that is to mature firm in the soil, disturbing its roots as little as possible. If other plants are twined about the one that is to remain, the larger these entwining plants become the more the entwined plant is disturbed in thinning. The beet plants send out their lateral roots very rapidly, and in thinning out the surplus plants these are liable to be more or less disturbed. The larger the beet that is to remain in the soil the more likelihood there is of its being disturbed; hence this thinning process must not be neglected. The beet plants that are to remain can be set back three weeks by such neglect, and in a dry season a number of the plants are likely to be killed, thus affecting the "stand."

CULTIVATION.

Cultivation has already been discussed to some extent. Harrowing is to be very strongly recommended in the cultivation of sugar beets. Three things must be kept in view in cultivation: First, the beets must be kept absolutely free from weeds and grasses, so that the beneficial effects of the sun and air may be fully realized; second, the ground must be kept loose for the same purpose; third, in case of dry weather the soil must be kept stirred, in order that a dust mulch may be sustained to prevent evaporation of moisture. Frequent hoeing by hand is highly beneficial to the crop.

HARVESTING.

The time of harvesting is governed by the time of ripening of the beets. This ripening is made apparent by the outside leaves of the plant taking on a yellowish tinge and drooping to the ground. An experienced eye soon learns to detect a field of ripe beets that is ready for harvesting. The beets having now finished their work, the next step of the grower must be governed by his locality. If he is in a section where there is a probability of rain, the beets must be harvested and placed in silos. This should be the case in most of the sections where rain conditions prevail. Such places usually have heavy rains in September and October, followed by more or less warm weather. The effect of the rain will be to cause the beets to begin growing again, and if the rains are heavy and followed by warm days, it is possible for a whole crop to be lost so far as fitness for factory purposes is concerned.

SILOS.

It is the custom in such localities to haul the beets to the factory if possible. If it is not possible to do this, they are gathered and placed in long ricks or piles on the surface of the ground. The bases of these ricks or piles are from 3 to 3½ feet wide and the height from 3 to 4 feet, tapering toward the top. Along each side of each rick several furrows are run with a stirring plow in order to loosen the dirt. The ricks are then completely covered with this dirt by the use of shovels. This covering is put on to the depth of about 6 inches, occasional air spaces or ventilators being left on the tops of the ricks, for which purpose are commonly used tiling or

small elongated wooden boxes, or simply straw, the object being to prevent fermentation.

Storing the beets in this way is called "siloing," and the ricks or piles are called "silos." These silos are closely watched, in order that no heating may occur to cause fermentation, which lessens the sugar content of the beet. The ricks are opened occasionally by way of inspection. It is the aim of the grower, as already stated, to get the beets to the factory as soon as possible, but this will depend on "his turn." In case he is delayed in this way until cold weather comes on, these silos are covered with straw, manure, or something of that sort, and then an additional amount of dirt is thrown on the straw covering. In this way it has been found that the beets will keep in very good condition until the last of January, if necessary.

It might be stated in this connection that it does not necessarily follow that beets are lost even if they should be frozen solid, as the factories can readily work them frozen, and, in fact, some factory superintendents say they prefer to work frozen beets. The one thing to be guarded against in the case of frozen beets is thawing. In California, where rains or freezing are not liable to occur, after the beets have ripened and have gone into this state of rest they are allowed to remain in the field until the grower is notified by the factory that his beets must be delivered, when they are harvested and taken to the factory. Thus the expense of siloing is avoided.

Feeding Value of Sugar-Beet Pulp.

The residue of the beets after the extraction of the juice is called pulp. It is the principal by-product of the beet-sugar factories. The value of this pulp as a food for stock makes it a matter of prime importance in the development of the industry.

INCREASE OF INTEREST AMONG FARMERS AND STOCK FEEDERS.

Aside from the question of sugar production, the sugar beet is slowly but surely winning favor with the farmer as a product to be grown and stored for stock feeding. Every year adds considerable experience in this direction, and the farmers are finding that they can make sugar beets almost as profitable grown for a feeding crop as for factory use. Sugar beets and the pulp from them fill two functions when fed to stock. First, they have a nutritive value of their own, and second, they have a sanitary effect as an aid to digestion. A food ration consisting entirely of corn and water is a rather intense sort of ration, and, as is well known by stock feeders, one that is liable to break down the animal in the effort to fatten it. If we introduce with this corn ration sugar beets or sugar-beet pulp, experience has shown that we have done a great deal to ward off the bad effects of the condensed ration. We have introduced an item of food which, instead of requiring so much digestive work on the part of the animal, actually serves as an aid to digestion. Many farmers are now growing sugar beets regularly, and using them as a part of all the food rations fed to animals of various kinds. A considerable number of successful farmers hold the belief that this kind of feeding will solve the hog-cholera difficulty and many other diseases affecting the digestive organs of animals. Large stock feeders of the West are coming to the habit of growing sugar

beets for fattening purposes as regularly as they grow corn. While the feeding of sugar beets is important, it can only be recommended to farmers who are not favorably situated for delivering the beets to a sugar factory. After the beets are grown, if there is a sugar factory near enough, they should be delivered and the sugar extracted; then the farmer should feed the pulp, which is almost as desirable for the purpose as the beets themselves.

When the farmers of this country come to understand fully the desirability of beet pulp as food, and its cheapness as compared with any other kind, then will the beet-sugar industry as a whole be much more popular with the farming class. Take the State of Michigan, for instance. There are now nine factories operating in that State. These factories have a combined capacity, at a moderate estimate, for turning out 225,000 tons of pulp per annum. This pulp is sufficient in amount to form an important item in the daily food ration of 22,500 dairy cows, or to enter as an important item into the food ration of 45,000 fattening steers during their fattening season. This gives some idea of the revolution which the sugar industry is going to work on the stock interests of that State when those interests come to fully comprehend the magnitude of the industry; yet this was all brought about in one year's time. None of these new companies gave any considerable attention to the subject, so absorbed were they with the completion of their factories in time for the campaign. When the time approached to start the fires in the factories, the question arose, What is to be done with the pulp? Some of the companies offered this pulp to the managers of the stock yards in Chicago, and offered it f. o. b. if they would simply take it away. The stock-yard men started an investigation to ascertain if the pulp would be of any value to them. Other factories simply planned from the beginning to dump their pulp into marshes and other waste places to get it out of the way. All this goes to show that very little information existed in Michigan among the stock feeders as to the value of this pulp for feed. This point is emphasized by the fact that the managers of the stock yards had to investigate the subject to find out whether they had better take this free pulp or not. This also illustrates the fact that we can build factories a great deal quicker than we can educate the people with reference to the benefits to be derived from them.

In this connection I offer some testimony touching the value of sugar-beet pulp given by those best posted in this country, men who have represented large interests and have given the subject a great deal of careful and intelligent consideration.

TESTIMONY OF FEEDERS AND OTHERS.

Mr. Arthur Goetz discussed the subject of pulp feeding in his address before the Trans-Mississippi Commercial Congress held at Wichita in 1899. He is manager of the sugar factory at Carlsbad, N. Mex. He

has been a close investigator of the subject for the purpose of intelligently recommending the pulp to the stock-feeding interests of New Mexico. He has fed at his own concern 6,000 head of sheep, and is thoroughly posted on this subject. He says:

The pulp is one of the best and cheapest feeds for cattle and sheep. As a milk-producing food it is unexcelled. While it is true that the pulp soon ferments after being thrown on the dump or siloed, still there is nothing in fermented pulp that is in any way injurious to dairy cows or any other stock; on the contrary it is better when in the fermented state than when fresh. Speaking from actual experience in Carlsbad, N. Mex., during the campaign over 5,000 head of sheep were fed in pens adjoining the factory grounds on pulp and alfalfa. The feeding was in every way a success, and the gentlemen owning the stock are now ready to contract for the entire output of pulp next season. We also supplied pulp to many farmers, including one large dairyman. Experience has demonstrated that where cows are fed on pulp the butter is of much finer texture and better lasting quality for shipment. Pulp contains about 90 per cent of water and 10 per cent of solids. The solid matter is composed mostly of the cell walls of the beets, and hence contains considerable crude fiber. It is best, however, to feed it with a coarser ration, such as bran, alfalfa, sorghum, etc. A cow will eat about 50 pounds a day; a sheep from 7 to 10 pounds. All who have tried the pulp, and given it a fair test, pronounce it an undoubted success. The feeding proposition is one of the principal adjuncts of a beet-sugar factory.

The following is from the address of the Secretary of Agriculture, Mr. Wilson, at the Clear Lake, Iowa, meeting and bears forcefully on the subject of the value of pulp feeding:

The most profit from growing beets will be had by the neighborhood that feeds the by-products or pulp to the dairy cow. We grew beets and other roots at Ames so as to have something of that kind to give to all the animals on the place in winter time. Europeans who have had experience, feed this by-product to every animal on the place. The managers of the Agricultural College of Iowa, where the finest animals in the United States are found, and where the best beef, mutton, and pork ever taken to Chicago are finished, find it necessary to have roots; and I have no hesitation in saying that the Iowa farmer can afford to grow roots for his animals, no matter how cheaply he can get other feeds. The Iowa farmer can afford to grow sugar beets for the pulp alone. The carbonaceous matter that goes to make the sugar is of no value to the dairy cow, which has all the carbonaceous matter she requires from her hay and corn and other carbonaceous feeds. This pulp is a necessity in the finishing of our fine steers.

We have come to the time when we must keep an eye on the South American republics. The Argentine Confederation has learned to grow alfalfa, and is sending very fat grass-fed animals to the European markets. We must send something better than they possibly can produce; we must finish animals young and finish them completely, and put such a product on the market as the South American can not compete with. Well-informed dairymen are aware that the dairy cow must have a highly nitrogenous ration in order to do her best work. For this reason the by-products of the mills are purchased—bran, oil meal, etc. When the sugar content has been removed from the beet, the nitrogenous element is left in the pulp, and the nutritive ratio is reduced to something like the nutritive ratio of oats, which makes a very valuable feature in the ration of the dairy cow. The neighborhood producing sugar and butter and sending these things into the world's markets will never reduce the fertility of the soil, for the pulp is returned to the fields through the domestic animals. And this is quite an important consideration, when we are thinking of introducing new crops. We are admonished by the experience of our

fellow-citizens in the East and South and West in this regard that we should avoid reducing the fertility of the soil as they have reduced and are reducing it. It is true we have a richer soil than the people in New England and the Southern States but we have no richer soil than the people in the valleys of the Rocky Mountain States and the Pacific coast States, and they have succeeded in so reducing the fertility of their lands that they take a crop of wheat only once in two years. We must avoid reducing Iowa soils to this condition. Here is a promising crop that will grow on what comes from the atmosphere and not what comes from the soil.

In making arrangements for furnishing beets for a factory, it should be distinctly understood that the by-product, the pulp, does not belong to the factory, but to the man that furnishes the beets, and on this basis only should the farmer agree to contribute raw material to the factory. It is true that if this arrangement is made, a different basis of valuation for beets would have to be made. Of course, the option should be given to the farmer whether he wanted to take his pulp or not. The point I desire to impress upon you is, that if the farmer desires to have his pulp back, he should have the option of taking it; and my advice is to take it home and feed it to the dairy cows and young animals, the brood sows and brood mares and everything that is being fattened.

The following is a report made by Mr. John Reimers, of Grand Island, Nebr.:

As requested in your favor of the 13th instant to I. R. Alter, I wish to give you my opinion of four years' experience in feeding beet-sugar pulp to cattle.

I consider it a valuable food in connection with grain and other feed, as it is a great digestive food and appetizer. It has some fattening qualities, but I do not depend on it for that purpose, but mainly to digest the other foods.

When I begin feeding I use for the first few days from 20 to 25 pounds of pulp per head daily, with hay and a little grain or meal mixed with it. Then I increase gradually to 40 or 50 pounds per head. I have also tried 80 to 90 pounds per head, but am positive that this is a disadvantage in fattening cattle, as they eat less grain and meal. Too much pulp is inclined to be loosening. Cattle can be put on full feed of grain much quicker with pulp, as it helps to digest the food and lessens the danger of overfeeding or getting the cattle stalled and foundered.

After feeding from ninety to one hundred days, I would advise going back gradually to 20 or 25 pounds of pulp per day and increasing the grain food, of which each feeder must judge for himself the amount his cattle can stand.

Cattle eat as much grain per day with the limited amount of pulp as they do without it, but this food in connection produces flesh more rapidly and thereby shortens the feeding season.

I find it better to feed ground feed with pulp rather than whole grain, but the pulp is beneficial with any kind of food. I have found, when feeding pulp with the same amount of roughness and grain that generally is required in the West to fatten cattle, that I would put on an extra gain of from 50 to 75 pounds per head; or I can make the same amount of gain as I obtain in the ordinary way of feeding in three-fourths of the time and save considerable grain and roughness.

The pulp-fed cattle will sell as readily as any other, as they dress and ship as well, even for export, which I myself have tried. I consider the pulp also a great food for stock cattle, if mixed with roughness, as it is a wholesome food and makes young stock thrive and grow. Cattle will eat poor and damaged roughness, which they otherwise would not touch, if mixed with pulp.

I have fed fresh pulp direct from the factory and also so-called sour pulp after it has been in silo. The pulp will keep in silo for years, but it will shrink some. The result is virtually the same in feeding either kind of pulp, and I consider them equally good, only that sometimes it takes three or four days before all the cattle learn to eat the sour pulp, while they will all eat fresh pulp readily the first day.

In talking with others having had extensive experience in feeding pulp to cattle, I secured facts in the main agreeing with the above report. All appear to agree that pulp feeding aids the work of digestion; that the same amount of feed adds more fat and flesh to the animal; that an animal will be prepared for the market six weeks earlier, showing a wonderful economy of time and feed. The gentleman making the above report is connected with the Grand Island Live Stock and Commission Company, and has had an extensive experience with the cattle and sheep feeding industry.

The following letter is from Mr. R. M. Allen, general manager of the feeding station of the Standard Cattle Company, Ames, Nebr., where a new factory has recently been completed and put in operation. The letter bears date of March 27, 1900:

I send a report from our sheep feeder, and will attempt some answer to questions he has not answered. You can attach his report to cover details that I do not mention.

There is no preparation required for beet pulp and ours is shipped directly from the factory to our cattle barn, where it is fed to sheep immediately. The surplus that accumulates beyond requirements is thrown from the cars near the factory into a large pile awaiting use after the campaign is over and the fresh supply from the factory is cut off.

From our experience I judge that it is not necessary to take pains to preserve the pulp. At some sugar factories more or less expensive silos have been made, one, for instance, at Ogden the past summer, and I understand that similar silos are built at Lehi, and, perhaps, at some factories in California. I have no doubt there is a saving of pulp by the use of these silos, but I should judge the interest on the cost of these silos and the additional labor required in getting the pulp out would exceed the value of pulp lost.

We expect a feed of pulp to be about 10 pounds per head per day for sheep, and 50, 60, or 70 pounds for cattle. In the experiment of the winter 1892–93 we fed a section of cattle in our barn as much as 100 pounds of pulp a day for a considerable time, and the cattle continuously ate that amount. I think no rule for the feeding of pulp is necessary; I do not think it is important whether a greater or less amount of it is fed in proportion to rough forage and grain fed with it. My idea would be, when on a full feed, to give less than a full grain ration in order to be certain of securing some economy in the use of pulp. I should, therefore, feed to cattle, for instance, anywhere from 40 to 60 pounds of pulp and let them have all the rough forage they wish.

The kind of cattle the pulp is to be fed to cuts a very important figure, also the climate in which the pulp is fed. I hear of exceedingly good results in feeding pulp in Utah and elsewhere, and even without any grain ration at all. Our climate in Nebraska is not the most salubrious in the world and it probably takes more concentrated feed, like grain, than some other climates.

I do not think it useful to attempt answering the question on the value of pulp as compared with other food stuffs. This question is often asked in regard to oil cake, for instance, and it is not possible to answer it. At the present time it is the general belief that the principal value of pulp will be found in aiding digestion and maintaining sound health of animals; it has, also, unquestionably a food value. I do not make any attempt, however, to estimate the value of pulp in units as compared with units of some other kind of food. Our experience up to this time has been only to the extent of an experiment with 275 cattle in 1892–93, and our sheep feeding the past winter still going on. Up to this time our experience is short and imperfect.

As our factory was not finished until the 8th of January, 1900, we were deprived of the use of pulp several months of the time we should have been using it.

I believe that the use of pulp will enable us to fatten cattle with less grain than it has been our practice to use, or, if we make the cattle eat an equal amount of grain, that they will be fattened within a shorter time. I prefer, however, to make a saving of grain and take a longer time for fattening the cattle, as the valuable results will be more certainly secured by taking plenty of time to do it.

No one can answer the question, as to the comparative commercial value of pulp. We have not considered this question, as our cattle company will get the pulp product of the factory for a series of years without cost, except the expense of taking it away.

I have not written or published anything at all about the use of pulp, because up to this time we have not had sufficient experience or data to enable me to give results or precise figures of any kind. It was my purpose in attempting to promote a factory at this point to secure pulp for feeding cattle and sheep for the benefit of the business of our cattle company. This was the initial idea of the whole project and I confidently expect that our experience in the future will prove that the use of pulp will be of sufficient value to give us an advantage in feeding animals for the food supply as compared with our basis of business for the last fourteen years. In course of time I shall be able to give our actual experience, which will be valuable. In the feeding of sheep the past winter, we feel very confident that we are on the right track and that our future feeding will be successful.

The following is the report of the feeder of the Standard Cattle Company at Ames, Nebr., which was transmitted by Mr. Allen, the manager:

(1) How is the pulp prepared?

The pulp is the usual diffusion pulp, loaded when fresh onto the cars at the factory and used immediately.

(2) How is it preserved?

The surplus pulp produced by the factory over what we could use was unloaded from the cars at convenient points on the railroad into large piles alongside the track and thus left until used. About 10 to 12 inches of the outside of the pile decayed and formed a dense mass which made a silo for the remainder, keeping it in very good condition. We are now using pulp that has been kept in this way for about two months, and it is all right.

(3) How is it fed, including food ration?

The pulp is fed in troughs similar to the troughs ordinarily used in sheep feeding, but somewhat deeper, so as to hold the amount of pulp necessary. The pulp is first scattered in the troughs and the grain scattered on top of it; afterwards they are mixed thoroughly. The sheep are fed twice daily.

We commenced feeding pulp by giving 1 pound per head per day and mixing this with a grain ration which at that time amounted to 0.9 pound for lambs and 1.1 pounds for sheep. We gradually increased the pulp ration until it reached between 9 and 10 pounds per head per day for sheep, and between 7 and 8 pounds per head for lambs, which was about all they would eat.

(4) What is the value of pulp as compared with other feed?

I have no accurate data.

(5) What is the extent of your experience?

The present season.

(6) Does it require less grain and less time to produce the same result?

I think it requires less time to fatten and consequently less grain. In this way, on a full ration, such as would be used without pulp, I believe sheep will fatten in considerably less time, which will result in a decrease in the amount of grain used, and I also think that a heavy grain ration can be fed with greater safety when using pulp.

(7) What commercial value has the pulp?

I have no data.

(8) What experiments have you made, and with what results?

We have not experimented. On December 12, 1899, we put somewhat over 16,000 sheep into our barn and fed them on a ration of ensilage and grain with plenty of hay until the factory provided us with pulp, which was about the 10th of January. We then commenced using the pulp as herein stated and have had very satisfactory results.

No danger need be apprehended from the laxative properties of pulp, but it is very diuretic in its effect, which necessitates the use of considerable litter for bedding.

THE FEEDING OF BEET PULP IN EUROPE.

The following statement regarding the feeding of beet pulp in Europe was prepared by Charles F. Curtiss, director of the Iowa experiment station, who also adds some testimony regarding the feeding of pulp in this country:

The value of beet pulp for feeding purposes is well known in all localities where beet-sugar factories are in operation, particularly in European countries where the art of feeding is most carefully studied. The pulp from a sugar factory is the refuse after the sugar has been extracted, just as gluten meal remains as a by-product of a starch factory after starch has been extracted from corn, and oil meal a by-product in the manufacture of linseed oil. Beet pulp contains 90 per cent water. Turnips and mangels contain about the same amount. This may seem like an undue proportion of water in a stock food, yet the turnip crop is fully as important a factor in the rearing of good cattle, for which Scotland has become so noted, as the corn crop in the Mississippi Valley States. The sugar factory removes the part of the beet that has comparatively little feeding value, and then the pulp is used to feed with corn. The pulp is fully as valuable for practical purposes without the sugar, and it is exceedingly well adapted to supplementing the usual farm ration.

Last summer the writer visited some of the famous beet-sugar producing sections of Germany. In the vicinity of Magdeburg the pulp was being kiln-dried and put on the market in a form somewhat resembling the gluten feed products of this country. This pulp in this condition was rated as one of the best feeds on the market and was retailing at a price equivalent to $1 per hundredweight, or about 60 per cent of the value of oil meal there. Used in the dried form it was found to be an acceptable and satisfactory feed for horses as well as cattle and sheep. The fresh pulp direct from the factory was also extensively used in the vicinity of the factories. Storing in silos was practiced, and the product kept without difficulty through the winter. In this form the pulp is particularly prized as as a feed for dairy cows.

It is not necessary, however, to refer to European countries to find evidence of the appreciation of this product as a stock feed. At Grand Island and Ames, Nebr., and at Lehi, Utah, and in fact all points where factories have been successfully operated, its value has been clearly demonstrated. At Ames, Nebr., the Standard Cattle Company has fattened 16,000 sheep during the past winter parly on beet pulp. An examination of the greater part of these sheep before they were sent to market gave ample evidence that they were well fattened, plump, thick-fleshed, and in prime condition. Their appreciation on the block is indicated by the fact that many of them topped the market, and some chops served on the table were thick, juicy, and of good flavor and altogether a better substitute for a prime turnip-fed English chop than is commonly produced on dry feed alone. Herein lies the secret of the so-called superiority of English-fed mutton and meats over American-fed products. Give the American feeder the foreigner's turnips or a satisfactory substitute for suc-

culent feed such as is furnished by beet pulp and John Bull will order his choice steaks and chops from the feed yards of the Mississippi Valley.

Concerning the feeding of these sheep on beet pulp at Ames, Nebr., the foreman, who has had a lifelong experience in handling sheep, said: "I never saw sheep do better. When we had pulp we fed three-fourths of a pound of cracked corn and 10 pounds of pulp daily, with from 1 to 2 pounds of hay. When the pulp had all been used we fed 1¾ pounds of grain to get about the same results."

The value of pulp at the factory is estimated at from 75 cents to $1.50 per ton, but those who have used it quite generally believe it has a higher feeding value than its composition would indicate, owing to the fact that it exerts a favorable influence on the animal system and to some extent stimulates digestion.

The product has been kept satisfactorily through the winter in Nebraska in good-sized piles in the open air. Only the outer crust spoils by freezing or fermenting. In foreign countries, however, silos are usually constructed for keeping the product.

Encouragement by State Bounties and Otherwise.

Whatever may be said of the wisdom of the policy of legislative encouragement to infant industries, a report on the sugar-beet industry in this country would not be complete without a statement of the facts concerning State legislation for the encouragement of this industry.

WHAT THE VARIOUS STATES HAVE DONE.

Nebraska.—The first State offering a bounty under which money was earned by manufacturers of sugar from beets was the State of Nebraska. One legislature placed the bounty on the statute books; the next one refused to appropriate money to pay the bounty and repealed the law. The claim for bounty was then taken into the courts.

Michigan.—In 1897 the legislature passed a law paying 1 cent per pound for refined sugar manufactured. The act appropriated $10,000 for the payment of bounties earned, and provided that any excess should be drawn from the general fund, and this act was to continue in force for seven years. The Michigan Sugar Company's factory was built and drew the bounty to the extent of the appropriation for its first year's run and put in a claim for the balance of the bounty over and above the appropriation, and in addition to this eight other factories were built and operated in various parts of the State during the year of 1899, manufacturing altogether 301,106,113 pounds of sugar, entitling them to $301,106.13, earned as bounty. Seeing this big demand that was going to be made on the treasury of the State, the legislature undertook to amend the law, giving one-half cent per pound instead of 1 cent, as under the old law. The governor of the State insisted that the law should be amended also by fixing a limit of $25,000 as the maximum that could be paid to any one factory. This was not done, and the governor vetoed the bill. This left the old law paying 1 cent per pound as bounty for sugar in force. The attorney-general of the State rendered an opinion to the auditor that warrants should not be drawn on the $200,000 appropriated for this purpose, claiming in his opinion that a bounty is not a proper expense of the State on which a

tax could be predicated. This leaves the bounty in the State of Michigan to be determined by the courts.

NEW YORK.—This State pays a bounty of 1 cent per pound on sugar of certain grade manufactured in the State from beets for which the farmers have received $5 a ton from the factory.

ILLINOIS.—The last legislature passed a bounty law giving to the manufacturers who make a high grade of refined sugar 1 cent per pound on condition that the factory pay $5 to the farmers per ton for beets. The bill was vetoed by the governor and failed to become a law.

SOUTH DAKOTA.—This State offers a bounty of 1 cent per pound for manufacture of sugar on condition that the factory shall manufacture at least 2,000 pounds per day; in addition it offers 2 cents per gallon bounty for the manufacture of molasses and sirup.

MINNESOTA.—The last legislature passed a bounty law offering 1 cent per pound on all sugar manufactured in the State, limiting the total amount of the bounty to $40,000, and stipulating that, if bounty be earned additional to this amount, the $40,000 shall be distributed pro rata among the factories participating in the bounty if more than one. The law also requires that the factory shall pay the farmer $4.25 for beets in order to participate in this bounty. The governor vetoed this bill and the legislature passed it over his veto.

WASHINGTON.—This State offers a bounty of 1 cent per pound on refined sugar manufactured in the State. The amount of bounty that will be paid by the State is limited to $50,000. It is limited to product of factories the construction of which shall be completed prior to November 1, 1901. It is to continue for a period of three years from the time such factories shall have been completed and in operation. "This act shall be taken and considered to be a contract and irrevocable with all such persons, firms, or corporations as shall complete the erection of such manufactory or manufactories prior to November 1, 1901."

IOWA.—The governor of Iowa in a message to the legislature recommended that beet-sugar factories should be exempt from taxation in the State for a period of ten years, and such legislation was enacted by the last legislature.

OTHER STATES.—Bounty legislation has been recently defeated in the States of Wisconsin, Indiana, and Pennsylvania.

BONUSES.

The establishment of the beet-sugar industry in this country, like a great many other industries—especially the creamery industry, has had experience with the bonus hunter. A beet-sugar factory can be capitalized, and built, and run on its own merits at a fair profit in any locality where favorable conditions exist, without the stimulus of a bonus being paid by the local parties. This statement presupposes

that the trade relations between this and other countries and legislation affecting the same shall remain as they are.

In visiting the various sections of the country for the past three years, not infrequently have I run across a local organization which was considering a proposition from some promoter who offered to construct a factory on condition that a stipulated sum should be offered as a bonus for constructing a 300 to 500-ton factory. The amounts demanded have ranged from $50,000 to $200,000. Sometimes it was stipulated that the bonus should be paid in cash; in other cases that it should be paid in lands for the factory site and adjacent thereto; and in still other cases it was stipulated that the amount should be paid in beets to be furnished the factory. I think that, if a locality has the right conditions for raising sugar beets and operating a factory, the bonus is entirely unnecessary.

In this connection, some remarks by Mr. C. E. Mitchell, already referred to in connection with the factory at Grand Junction, Colo., are pertinent:

> From recent experiences I want to call your attention to what I consider a serious menace to the beet industry, to wit, the starting of factories in localities where there is no intention on the part of the promoters to raise any beets to speak of, and the idea being to make money out of sale of lands and town lots, rather than from the manufacture of sugar from beets. If these schemes are carried on to any extent, there will soon be a number of factories that will not be able to show any production of sugar, and when a person honestly attempts to interest capital in new and legitimate beet-sugar manufacturing enterprises he will have these failures continually thrown up, and explanations of them will be very troublesome. It looks now as if the sugar-beet business was getting its share of fakirs, to say nothing of rash promoters who know and care nothing about the sugar industry, save as a means to filling their own pockets with bonuses, and worthless stocks and bonds which they are only too ready to unload on their friends.

Status and Prospects of the Industry as Reported by the State Experiment Stations.

I submit herewith reports from the directors of the various experiment stations throughout the United States on the progress of the beet-sugar industry, and on the status of the experiments being carried on in those States to ascertain the condition of those States for growing sugar beets and for manufacturing sugar from them. Requests for reports were sent to all of the State experiment stations that have been actively participating in these experiments for the past few years where results have indicated favorable conditions, and where efforts have been made to stimulate the manufacture of sugar.

Up to the time of sending in this report three or four States had failed to forward such data. If any of them are not represented under this head, it will be because no report has been received.

It will be noticed that quite a number of the States have reported that it is the judgment of the experiment stations in those States that the work of experimentation has been completed; the experiments have covered a series of years; the results have all been published in

the State bulletins; they have shown conclusively that such States have the necessary conditions for growing sugar beets of sufficient quality, quantity, and purity for the success of the beet-sugar industry. They therefore recommend that the work in their States in the future should be confined to the organization of companies, interesting capital, and educating the public in general on the benefits of the sugar industry to the State. The reports of the directors follow:

ARIZONA.

Report of Prof. R. H. Forbes, director of State Experiment Station, Tucson, Ariz., March 8, 1900.

Replying to your inquiry of March 3, I am sending you the advance sheets of our last bulletin on sugar-beet experiments for 1899, which contains full information on the topic desired. I also send you our bulletin of one year ago on the same subject. The work has all been done in Maricopa County, which contains the largest agricultural area in Arizona.

No factories were built in Arizona during the past year, and, so far as I know, no factories are as yet arranged for. The probabilities are that the Upper Gila is a more favored locality for beet raising than any other part of Arizona, and the station is this year placing a skilled workman at this point for the purpose of finding out what there is in this supposition.

No bounty is provided on manufactured sugar in Arizona.

The following is taken from the bulletin of the station:

Report by ALFRED J. MCCLATCHIE on sugar-beet experiments during 1899.

The experiments with sugar beets have been confined during the past year to the station farm near Phœnix. The principal object in mind was to gather data upon the irrigation of the crop. Other points involved in the experiments were the determination of the best time to sow the seed, the definite limits of the season of satisfactory germination of the seed, the best time to harvest the beets, and the changes that take place in the beets as they remain in the soil during the latter part of the summer.

AUTUMN-SOWN PLATS.

The beets sown September 21, 1898, were harvested March 30, 1899. The period from November 1 to February 10 had been unusually unfavorable for the growth of any kind of vegetables. As a result, the beets had not attained a proper size when the warm weather of spring caused them to begin to blossom. The experience of the past two seasons shows that the beets started before the cool weather of December and January will begin going to seed during the last part of March or early April, regardless of the size then attained. If the weather during the five or six months previous to that time is not too cool, a satisfactory root growth will be made before the tendency to put forth blossoms takes possession of the plants. The results from these autumn-sown beets were as follows: Average weight of beets, 8.3 ounces; yield of beets per acre, 7.9 tons; per cent sugar in beets, 11.5; purity coefficient, 79.3. If the beets had grown to the size they did during the preceding more favorable winter, the stand was sufficiently good for satisfactory tonnage. While waiting for them to reach a fair size, many of them began sending up seed stems. This probably accounts for the low sugar percentage.

EFFECT OF TIME OF SEEDING.

The beneficial effect of early seeding is shown in the results from plat 1, sown January 18. The beets of this plat had made such a growth by the time those sown in similar soil February 26 were up that they attained a much larger size before being checked by the hot weather of June. There seems to have been no other reason for the yield being so much greater than in plats 9 and 10, for example. The important point, as shown by the result, is to get the beets started as early as practicable, during the cool weather, that as much growth as possible may be made before the hot summer weather.

Tabular record of plats.

Plat.	Date of seeding.	Date of first irrigation.	Date of second irrigation.	Date of third irrigation.	June 26.				July 29.					August 10.		September 20.	
					Average weight of beets (ounces).	Yield per acre (tons).	Per cent of sugar in beets.	Purity.	Average weight of beets (ounces).	Yield per acre (tons).	Per cent of sugar in beets.	Purity.	Available sugar per acre in pounds.	Per cent of sugar in beets.	Purity.	Per cent of sugar in beets.	Purity.
1	Jan. 18	Mar. 3	Apr. 10	May 5	14.0	14.6	12.7	82.4	18.5	18.0	13.0	84.5	3,850	12.7	79.3	10.4	77.5
2	Feb. 13	May 7	.....	.....	6.0	5.5	14.2	79.5	6.4	6.5	15.0	73.1	1,235	14.8	75.4	9.8	68.6
3	....do ...	Mar. 29	May 30	.....	5.4	4.8	15.7	88.5	5.5	5.8	17.2	80.2	1,510	15.2	77.1	13.0	71.4
4	....do ...	....do ...	May 20	June 23	7.1	7.3	12.5	77.5	7.0	7.2	14.3	70.3	1,195	15.1	80.9	12.5	70.2
5	....do ...	May 8	.....	.....	7.1	7.2	15.2	81.9	7.0	7.2	15.9	72.0	1,415	13.8	72.5	11.1	62.4
6	Feb. 25	May 5	.....	.....	8.9	8.8	14.7	79.9	9.6	9.6	16.0	79.7	2,305	14.4	75.6	14.0	79.0
7	....do ...	May 20	.....	.....	8.8	8.8	14.9	83.4	8.9	8.9	17.0	83.5	2,615	14.7	77.8	13.5	75.0
8	....do ...	May 29	.....	.....	8.9	10.2	11.9	76.6	9.0	10.3	15.6	75.0	2,145	12.3	74.1	11.4	70.9
9	....do ...	May 5	June 15	.....	8.0	10.9	12.9	84.9	8.0	11.0	14.9	74.3	2,155	14.3	78.7	13.5	74.4
10	....do ...	Apr. 10	May 29	June 15	10.4	10.4	11.3	79.5	11.0	11.0	11.4	74.8	1,670	18.2	67.9	12.0	73.6
Averages					8.46	8.85	13.6	81.4	9.1	9.75	15.0	77.7	2,010	14.0	75.9	12.1	72.3

CALIFORNIA.

Report of Prof. E. W. HILGARD, director of State Experiment Station, Berkeley, Cal.

Success has been marred by the drought during the past season. Quality of beets has been good, but quantity has been deficient by 30 to 60 per cent. Roots assayed at this laboratory ranged from 10.9 to 22.7 per cent sugar and from 84 to 92 purity. For results of analyses in years past, see inclosed tables.

During the past year factories at Oxnard and Salinas have been completed. Efforts are being made to secure factories at Sacramento, Stockton, and Santa Rosa.

The State provides no bounties.

The experiment station is not in a position to supply data regarding yield per acre of sugar beets; it can give only the results of analyses of samples sent for examination.

The returns from counties from which only one or two samples were received must not be regarded as representing the best or even average results attainable. In many cases the samples thus received are sent by growers who have not given the proper care to planting or subsequent cultivation.

The following tables show results of analyses by counties of beets grown in the State for the years 1895 to 1897, inclusive:

Results of analyses of beets grown in California, 1895–1899.

1895.

County.	Sugar.			Purity coefficient.			No. of samples.
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Modoc	11.76	11.76	11.76	91.87	91.87	91.87	1
Butte	11.29	8.89	9.74	84.25	77.12	80.26	9
Colusa	14.92	9.29	12.48	91.06	74.32	85.21	4
Yuba	17.66	11.61	14.63	88.74	87.29	88.01	2
Sutter	4.90	2.33	3.45	52.90	35.74	45.30	3
Sacramento	6.10	6.10	6.10	64.86	64.86	64.86	1
Alameda	16.72	6.60	11.62	92.37	58.93	81.75	8
San Joaquin	14.88	7.68	12.28	91.99	69.77	86.27	9
Tulare	14.98	11.16	13.07	91.90	87.19	29.54	2
Merced	15.86	12.57	14.21	87.16	85.51	86.33	2
San Luis Obispo	15.98	10.60	13.31	89.93	74.38	83.36	14
Ventura	14.04	6.42	10.21	63.30	88.50	77.07	11
Santa Barbara	20.92	16.45	18.47	92.13	77.60	84.44	5
Los Angeles	19.36	8.70	12.56	92.16	75.47	85.07	72

Results of analyses of beets grown in California, 1895–1899—Continued.

1896.

County.	Sugar.			Purity coefficient.			No. of samples.
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Butte	17.17	11.05	12.69	92.31	74.80	81.94	8
Colusa	12.20	12.20	12.20	72.62	72.62	72.62	1
Yuba	18.70	13.84	16.84	94.44	91.65	92.76	3
Yolo	13.63	2.64	9.52	86.11	40.61	72.35	16
Amador	14.49	11.65	13.64	88.77	81.81	84.22	6
Sacramento	18.08	3.40	12.90	90.70	31.48	81.76	16
Sonoma	14.82	14.82	14.82	78.80	78.80	78.80	1
Solano	16.69	11.54	13.81	87.78	73.50	82.57	12
Los Angeles	18.98	5.18	12.85	92.61	56.26	83.67	18
San Luis Obispo	17.30	14.75	15.93	86.50	77.22	82.36	12

1897.

Yolo			16.50			82.30	1
Sacramento	20.60	7.80	15.30	90.60	71.60	84.50	36
Sonoma			10.70			73.50	1
Alameda			13.40			89.50	1
Santa Cruz			19.40			87.00	1
Tulare	11.90	6.30	8.80	76.00	65.20	68.40	5
Kern			6.90			53.60	1
Los Angeles	17.00	10.90	14.10	94.50	71.50	82.90	64

1898.

For the entire State	19.80	11.40	15.90	94.80	71.80	84.40	20

1899.

For the entire State	22.70	14.20	17.00	92.80	83.90	88.70	10

INDIANA.

Report from the State Experiment Station, Lafayette, Ind., C. S. PLUMB, Director.

The following table shows in detail the results of the experiments in growing sugar beets in Indiana in 1899. The beets were grown by farmers under the direction of the station, and the analyses were made by the station. The results are arranged by counties.

Results of experiments in growing sugar beets in Indiana in 1899.

County, and name of farmer.	Post-office of farmer.	Variety of beets.	Average weight of beets in ounces.	Per cent of sugar in the juice.	Per cent of sugar in the beet.	Coefficient of purity.	Class of soil.	Yield, tons per acre.	Date of planting.	Date of harvest.
Adams County: V. Linkler.	Magley	Kleinwanzlebener.	10.5	17.5	16.6	88.3	Black		Apr. 26	Oct. 18
Carroll County:										
J. Jackson	Delphi	Zehringen	14	11.5	10.9	80	Sandy			
V. C. S. Jordan	Cutler	Mangold	22.7	10.2	9.7	74	Clay		May 10	Oct. 13
Cass County:										
M. F. Grunelspacker.	Logansport	do	16.8	12.9	12.2	82.1	do	21.7	May 11	Oct. 9
Do	do	do	16.1	11.2	10.6	74	Black	20	do	Do.
Clinton County:										
Abner Byers	Frankfort	do	19.9	10.6	10	79.7	Sugar-tree.		Apr. 26	Nov. 8
Chas. E. Wilson	Rossville		13.3	11.6	11	75.8	Clay		May 15	Dec. 14

Results of experiments in growing sugar beets in Indiana in 1899—Continued.

County, and name of farmer.	Post-office of farmer.	Variety of beets.	Average weight of beets in ounces.	Per cent of sugar in the juice.	Per cent of sugar in the beet.	Coefficient of purity.	Class of soil.	Yield, tons per acre.	Date of planting.	Date of harvest.
Daviess County: John W. Whitesides.	Corning	Mangold....	8	16.1	15.3	83.4	Clay	10.3	May 2	Oct. 26
Dekalb County: A. M. Grogg.	Waterloo ...	Kleinwanzlebener.	17.8	14	13.3	82.4	Sand....	32.1	Apr. 29	Nov. 21
Fayette County: Ott Utter.	Columbia ...	Vilmorin ...	7.2	18.1	17.2	87.4	Clay	14.4	Apr. 27	Dec. 14
Fountain County: Ross De Haven.	Covington ..	Mangold....	12.7	10.5	10	76.6	Black...	10.4	June 4	Oct. 13
Grant County: Winslow Marshall.	Marion	Kleinwanzlebener.	10.1	15.3	14.5	86.4	Black sand.	15.5	June 3	Nov. 6
Do.....	.....do	Vilmorin ...	12.2	14.2	13.5	85.5	....do ...	8.7	....do ...	Do.
Hamilton County: John Wilson.	Sheridan ...	Kleinwanzlebener.	17.8	12.8	12.1	80.5	Black...	38.5	May 3	Sept. 24
Harrison County: Dr. Delus.....	Evans Landing.	Vilmorin ...	7.5	11.9	11.3	83.2	Sandy loam.	....	.....	Oct. 10
D. B. Tabler	Black Creek	Zehringen ..	11.2	11.7	11.1	74.5	Clay	16.6	May 1	Nov. 1
Henry County: John Parker.	Lewisville ..	Kleinwanzlebener.	10	13	12.3	80.2	....do ...	26.1	May 2	Oct. 31
Howard County: W. A. Costlow ...	Kokomo	Mangold....	13.6	14	13.3	81.4	Sandy clay.	14.1	Apr. 17	Oct. 13
E. H. Kirkandall.	Oakford	Vilmorin ...	24.5	10.7	10.1	71.8	Sandy ..	....	May 1	Nov. 28
Huntington County: T. E. Hawkins.	River	Zehringen ..	7.7	18.7	17.7	82.7	Clay	13.1	Apr. 21	Sept. 13
Jay County: W. F. Hilfiker ...	Salamonia ..	Kleinwanzlebener.	19.4	14.5	13.7	81.4	Black...	16.2	May 9	Oct. 13
David Hoover ...	Pennville...	Mangold....	11.5	17	16.1	84.2	Gravel..	10	May 16	Oct. 30
Henry McDonald	Powers	Kleinwanzlebener.	10.5	15.4	14.6	87.3	Black...	27.2	Apr. 25	Nov. 7
Kosciusko County: John T. Davisson ..	Milford	Mangold....	24.5	12.9	12.2	78.6	Sand....	26.1	Apr. 28	Nov. 18
Lagrange County: Herman Sabrofsky.	Seybert.....	Zehringen ..	13.3	12.9	12.2	77	Marsh ..	31.3	May 25	Oct. 7
Lake County: John Latta	Shelby.....	.....	8.4	12.2	11.6	82.4	Black sand.	....	.....	Sept. 28
P. J. Larson.....	.....do	.....	7.5	13.8	13.1	84	....do ...	....	.....	Oct. 16
Richard Fuller ..	.....do	.....	10.5	14.4	13.7	90	....do ...	....	.....	Sept. 28
Peter K. Love....	Leroy.....	Mangold....	16.8	12.7	12	80	Black loam.	25.2	June 3	Dec. 12
C. B. Benjamin...	.....do	.....do	26.2	12.4	11.8	78	....do ...	....	May 28	Nov. 16
Frank Dennis....	Shelby.....	.....	14.8	12.7	12	80.4	Dark sand.	....	June 25	Dec. 12
M. J. Allgrim	.....do	.....	16.6	12.6	11.9	80.4	Light sand.	....	June 5	Do.
Madison County: Elvin Gentry	Perkinsville	Zehringen ..	14	12.8	12.1	78	Sandy clay.	....	May 20	Oct. 5
Marion County: J. A. Hill	Broad Ripple.	Mangold....	12.8	13.1	12.4	80.3	Sandy ..	13.1	May 2	Nov. 28
Warren L. Phillips.	Indianapolis	Klienwanzlebener.	21	13.1	12.4	84.5	Black...	20	May 3	Oct. 11
Montgomery County: Reason Heath.	Alamo.....	.....do	3.3	9.8	9.3	70	Sandy ..	....	May 20	Dec. 4
Noble County: S. P. Simon.	Swan	Vilmorin ...	5.2	15	14.2	84.5	....do ...	....	June 1	Oct. 30
Ohio County: Ben. H. Scranton.	Risingsun ..	.....do	14	12.7	12	81.4	Sandy dark.	....	May 18	Do.
Perry County:	Rome	Zehringen ..	9.4	12	11.4	78	Stiff clay	16	May 29	Nov. 8
J. J. Wheeler .... Harden C. L. Pyle.	Bristow	Kleinwanzlebener.	2.6	12.8	12.1	79	Sandy clay.	....	June 3	Do.
Pulaski County: W. F. Early.	Medaryville	.....do	4.5	14.4	13.7	87.8	Deep muck.	....	May 13	Oct. 9
Randolph County: Geo. W. Comer.	Spartanburg.	Vilmorin ...	15.5	13.3	12.6	80.1	Light clay.	19.6	May 18	Nov. 8
Ripley County: Joseph Siefert.	Morris.....	Mangold....	13.3	12.2	11.6	77.8	Sandy ..	....	May 7	Nov. 2
Shelby County: W. H. Porter.	Morristown.	Vilmorin ...	35.1	10.7	10.1	75.8	....do ...	6	Apr. 28	Oct. 13
Spencer County: Tobe Phipps.	Rockport ...	.....do	9.8	9.9	9.4	66.4	Dark ...	24.8	May 15	Oct. 16

Results of experiments in growing sugar beets in Indiana in 1899—Continued.

County, and name of farmer.	Post-office of farmer.	Variety of beets.	Average weight of beets in ounces.	Per cent of sugar in the juice.	Per cent of sugar in the beet.	Coefficient of purity.	Class of soil.	Yield, tons per acre.	Date of planting.	Date of harvest.
Starke County:										
Frank Ross	North Judson.		9.4	16.8	15.9	85.3				Sept. 5
Do	do	Vilmorin	2.9	14.7	13.9	87.5	Yellow sand.	8	May 28	Oct. 11
Do	do	Kleinwanzlebener.	7	15.3	14.5	91	do	8	do	Do.
Chas. Kortum	do		7	15.5	14.7	86.1				Oct. 3
John Hopp	do	Mangold	16.6	12.9	12.2	83.7	Sandy		May 9	Oct. 12
Do	do	do	16.9	14.	13.3	84.3	do	12	do	Dec. 2
John Ludtka	do		16.1	12.4	11.8	85.5				Oct. 12
Do	do		16.9	13.1	12.4	82				Dec. 2
Peter Mosher	do		15.2	14	13.3	87.6				Oct. 30
Do	do		21.7	12.9	12.2	82.6				Nov. 2
F. C. Teach	Bass Lake		12.2	14	13.3	87.6				Nov. 30
Frank Boryanck	North Judson.		16.4	15	14.2	90.4				Nov. 3
Do	do		19.2	16.5	15.7	85.5				Nov. 17
Mike Boryanck	do	Vilmorin	41.4	11.8	11.2	82.5				Nov. 16
Ben Fleshman	do		23.8	12.5	11.9	82.7				Dec. 2
John Spinner	do	Kleinwanzlebener.	15.2	14.8	14	81.3				Dec. 7
D. M. Baldwin	Knox	Zehringen	15.5	16.4	15.6	86.3	Clay	18	May 15	Dec 18
St. Joseph County:										
Adam Moore	Woodland	do	16.4	14.9	14.1	85.7	Sand	26.9	May 1	Oct. 18
Chas. L. Stucky	South Bend.	Kleinwanzlebener.	11.7	15.5	14.7	90.1	Sand loam.	13.1	June 1	Nov. 6
Steuben County:										
John N. Shove	Angola	Vilmorin	14	15.3	14.5	80.5	Clay	26.5	May 24	Oct. 9
Jno. Hardenbrook	Ray	Kleinwanzlebener.	15.7	12.4	11.8	81.5	Black loam.		May 20	Do.
Sullivan County: Julius Koester.	Merom	Vilmorin	8.4	9.5	9	75.4	Clay and sand.	4	May 15	Oct. 12
Tippecanoe County:										
Chas. Marstellar.	Lafayette	Kleinwanzlebener.	16.4	10.8	10.2	75.5	Yellow clay.	15.6	do	Oct. 4
Do	do	Mangold	14	12.6	12	82.9	do	11.3	do	Do.
Do	do	Zehringen	15.9	12.4	11.8	81.5	do	17.4	do	Do.
Do	do	Vilmorin	14	11	10.4	75.8	do	15.2	do	Do.
Station. (See end of list.)										
Tipton County:										
Wm. L. Berryman	Tipton		10.5	11.2	10.6	67				Oct. 11
N. F. Ploughe	Kempton	Mangold	16.8	11.3	10.7	76.9	Clay	23.9	May 22	Nov. 14
Vermilion County:										
David Metzger	Gessie	do	14	12	11.4	80	do		May 6	Sept. 30
Vigo County: L. G. Heelman.	Terre Haute	do	18.2	12.6	12	80	Sandy		May 3	Nov. 28
Wabash County: Lavina Smith.	North Manchester.	Vilmorin	9.3	12.8	12.2	80	Clay	22.5	Apr. 25	Oct. 16
Wells County:										
Joseph Brauer	Barbers Mill	do	19.6	11.3	10.7	70	Black		May 5	Oct. 14
Levi Osborne	Prospect	Mangold	10.9	15.1	14.3	82.5				Oct. 16
Whitley County:										
Aaron Marten	South Whitley.	Vilmorin	20.3	12.9	12.2	80.1	Clay	12.6	May 6	Do.
Reo Johnson	Columbia City.	Kleinwanzlebener.	14.5	16.5	15.7	91	Heavy clay.	11.1	May 15	Oct. 27
W. F. Bolinger	do	Mangold	19.6	13.1	12.4	77	Loam	32	May 20	Nov. 28
Tippecanoe County: Experiment station.	Lafayette	Vilmorin	8.2	15.3	14.5	94.4	Dark second bottom loam.	9.5	Apr. 29	Oct. 27
Do	do	Kleinwanzlebener.	14	12.8	12.1	88.2	do		do	Oct. 26
Do	do	Mangold	11.7	11.8	11.2	84.2	do	12.7	do	Oct. 27
Do	do	Zehringen	7.2	16	15.2	94.7	do	13.6	do	Oct. 26
Do	do	Vilmorin	12	14.9	14.1	89.2	do		do	Oct. 27
Do	do	Kleinwanzlebener.	6.4	13.4	12.7	85.3	do		do	Oct. 26
Do	do	Mangold	8.5	13.5	12.8	90	do		do	Oct. 27
Do	do	Zehringen	12.2	14	13.3	87	do		do	Oct. 26

IOWA.

Report of Prof. C. F. CURTISS, Director of State Experiment Station, Ames, Iowa.

The Iowa Experiment Station has conducted experiments in growing and testing sugar beets covering a period of about ten years with highly gratifying results. This work includes tests made in nearly every county in the State and extending over a wide range of climatic conditions. It is safe to say that beet-sugar production in Iowa is no longer an experiment or an uncertain proposition. It has been clearly demonstrated that the State is eminently adapted to practicable and profitable sugar production. Probably a more unfavorable season, for the proper ripening of the crop and development of saccharine matter in the beet, than that of 1898 will rarely if ever occur, owing to the excessive rainfall during the autumn season; yet the average results of twenty samples taken at different dates from the station grounds indicate beets of superior quality:

Date.	Per cent of sugar in beets.	Coefficient of purity.
October 15	12.58	81.50
October 22	12.33	81.23
October 29	12.88	84.89
November 14	13.94	85.93
November 11	12.29	77.58

The foregoing results show that not only can good beets be grown in what may be termed an off year in Iowa, but they also clearly demonstrate the importance of harvesting the crop at the right time, which generally ranges from the middle or the latter part of October to the first week in November. The last samples were taken after the late rains had started a new growth of the beets and caused deterioration of the crop.

The results of testing the adaptation of Iowa's soil and climatic conditions in other parts of the State have been equally encouraging where right methods have been practiced. All we need now is the factories and a knowledge of how to grow the beets successfully.

The following additional report is made by James Atkinson, professor of agriculture:

Twelve years ago the experiment station began to investigate the subject of growing sugar beets for commercial purposes. Not only have beets been grown for that length of time on the station grounds, but farmers from every county in the State have cooperated with the station by growing the crop and sending representative samples to be tested. A brief summary of the work for these years will show that the conditions throughout the State are favorable to the growth of beets of superior quality.

During 1888 and 1889 only 6 samples were analyzed. The average sugar content of these was 12.38 per cent and the purity coefficient 73.93. During the next four years 644 samples were analyzed. Of this number 334 tested above 12 per cent of sugar. The remaining 310 samples were below the standard, but in the majority of cases the poor quality could be accounted for by the soils being improperly prepared, the crops being neglected, or the beets being harvested prematurely.

In 1897 1,200 samples were analyzed by the station chemist. These were sent from 88 counties. Of this number 663 were accompanied by a description of the conditions under which they were grown which indicated that the directions sent out with the seed had been complied with. The average sugar content of these samples was 13.07 per cent and the purity cofficient 77.40. Of these samples, 290 contained an average sugar content of 14.51 per cent. The variety test at the station in 1897 is given in the following table:

Variety test at Iowa station, 1897.

Variety of beets.	Sugar per cent.	Purity coefficient.
Schrieber	15.09	82.23
Original Kleinwanzlebener	14.72	82.62
Dramaz Élite	14.30	81.60
Zieman	13.90	79.72
Dippe	13.83	78.81
Vilmorin Improved	13.32	80.11

Besides varieties the experiments of 1897 included 64 plots. Fourteen of these gave an average yield of 22 tons per acre. The sugar content of the samples taken from the 64 plots averaged 14.19 per cent, and the coefficients of purity 81.47.

Since the publication of the results of 1897 it seems to be a settled question in the minds of Iowa farmers that the conditions of the State are favorable to the production of beets of superior quality. Since that time there has been little demand for seed, and the work during 1898 and 1899 has been largely confined to the station.

Experiments in methods of culture and fertilizing were conducted during these years. The result of these proved beyond doubt that a soil that is capable of producing good corn will also produce good beets. Representative roots were taken from 20 plots early in November and analyzed, the average result being a sugar content of 13.94 with a purity of 85.93. The poorest sample of these, which was taken from a soil that had been heavily manured, contained 12.33 per cent of sugar.

There will be no factories built in the State to care for the 1900 crop. At the present time 3,500 acres of beets are contracted for to be delivered at the Pekin factory, Illinois, and the St. Louis Park factory, Minnesota. Should this venture prove successful there will in all probability be factories established at Des Moines, Storm Lake, and Fort Dodge to handle the crop of 1901. The question now is not whether Iowa conditions are suited to beet growing, but whether the farmers will take hold of this new industry. It is being favorably considered in localities where dairying is engaged in, and properly so, as one industry is but the counterpart of the other. Our legislators are favorable to the establishment of the industry, as indicated by a bill passed by the house exempting sugar-beet factories from taxation for a period of years. However, the idea of fostering the industry by a bounty is not favorably considered by them.

MINNESOTA.

Report of Prof. HARRY SNYDER, chemist of State Experiment Station, St. Anthony Park, Minn.

Beets grown for our beet-sugar factory last year were in every way fully up to our average reported for former years. The station made comparatively few analyses of last year's crops, and the results have not as yet been compiled. We have at present one factory in the State, at St. Louis Park, built in 1898. I know of no localities where factories are seriously contemplated, but at a number of places interest is taken in the beet-sugar industry, and there has been some discussion in regard to building a factory. These places are Albert Lea, Austin, Mankato, Winthrop, St. Cloud, Madison, and Dawson.

MISSOURI.

Report by H. J. WATERS, Director of State Experiment Station, Columbia, Mo., March 12, 1900.

We made comparatively few experiments with the sugar beet in this State during the season of 1899, with results similar to those of former years.

We have not published result of last year's work, but it will not differ essentially from that of former years, published in the bulletins sent you.

No factories have been built in this State during the past year, and so far as I know no arrangements are being made for factories in the future.

No State bounty is offered and no request has ever been made upon the legislature for this aid.

The following is taken from the printed report of the experiments made in 1898:

A tabular comparison of the mean results obtained by the Missouri station and in the laboratory of the Department of Agriculture in 1897 will be interesting:

Results of analyses of beets grown in Missouri in 1897.

Where beets were analyzed.	Total number of samples.	Average weight.	Sugar in juice.	Purity coefficient.
		Ounces.	*Per cent.*	
United States Department of Agriculture	324	20	11.7	73.5
Agricultural Experiment Station of Missouri	301	28	11.1	74.9

The average size of the samples received at Washington was smaller than that of the beets analyzed at the Agricultural Experiment Station of Missouri, and this is doubtless the cause of the slightly increased mean percentage of sugar obtained in the laboratory of the Department of Agriculture. A general study of the results obtained leads to the inevitable conclusion that Missouri is not very favorably situated for producing beets of the highest quality. It is possible to secure, in some instances, results which are exceptionally favorable, but that such results could be secured continuously, and from season to season, is not probable. The data show that the whole of the State of Missouri belongs in the same category, in respect to growing rich sugar beets, as the southern parts of the States of Ohio, Indiana, and Illinois. Even the northern counties of Missouri are too far south to give best results. It is evident, however, in so far as yield is concerned, that Missouri is probably the equal of any State in the Union for growing beets of fine size and large tonnage per acre. Unless exceptional conditions favorable to manufacture are found in the State, it is not probable that the sugar-beet industry will gain a foothold for some time in competition with the more favorable localities.

The results for 1898 may be summarized as follows:

Sixty-nine counties out of 114 furnished samples.

The average weight of the beets sent to the station was 24 ounces.

The average percentage of sugar in the juice was 8.73; in the whole beet, 8.29.

The highest percentage of sugar in the juice was 14.58, from Atchison County.

The lowest percentage was 3.72 from Montgomery County.

The average coefficient of purity was 72.52.

Only five samples out of the 150 analyzed showed as much as 12 per cent of sugar in the beet.

MONTANA.

Report by Prof. S. M. EMERY, director of State Experiment Station, Bozeman, Mont., March 19, 1900.

Beets did as well as usual last year. I inclose you our beet-sugar bulletin. I think that it will cover the points on which you desire information. There is nothing to prevent the production in Montana of the sugar supply, judging from the results obtained by us in our investigations. We have shown 23 per cent sugar, and in addition we can begin manufacturing the sugar in August. I note in a recent circular from Dr. Wiley that he advises planting as early in the spring as possible. We have feared frosts heretofore, although it is our experience that the frost is not as injurious to vegetation in Montana as elsewhere, and am sure we might have planted profitably three weeks earlier. This, of course, would have a tendency to prolong the season.

Average results of analyses for 1897.

Locality.	Weight of beets.	Degrees Brix.	Per cent of sugar in juice.	Purity coefficient.
	Ounces.			
Montana Experiment Station	14.8	20.9	17.1	81.9
Gallatin Valley	23.4	18.3	14.4	76.4
Livingston	24.7	19.3	14.5	74.3
Kalispell	32.0	18.6	14.1	76.2
Missoula	32.0	17.0	12.6	73.6

Cooperative tests, 1898.

Lab. No.	Description.	Weight of beets.	Degrees Brix.	Per cent of sugar in juice.	Per cent of sugar in beet.	Purity coefficient.
		Ounces.				
780	I. D. O'Donnell, Billings	11	21.5	13.4	12.70	62.32
781	D. R. Thornber, Chinook	46	19.5	16.4	15.58	84.10
782	....do	47	17.0	12.8	12.16	75.4
830	I. D. O'Donnell, Billings	18	15.7	11.3	10.73	71.3
831	....do	17	17.0	11.5	10.92	67.6
832	Bitter Root Stock Farm, Hamilton, from experiment station seed	45	21.0	16.6	15.77	79.1
833	....do	26	21.3	16.7	15.86	78.4
834	....do	31	22.5	17.3	16.43	76.8
835	....do	27	22.3	18.6	17.67	83.4
836	Bitter Root Stock Farm, Hamilton, seed bought in Chicago	59	14.9	11.3	10.73	71.0
837	....do	34	16.8	11.1	10.54	66.1
838	....do	58	17.2	12.8	12.16	74.4
839	....do	74	14.2	9.5	9.02	66.9
840	Chas. Gardner, 10-acre farm, Billings	24	13.5	8.4	7.98	62.2
841	....do	31	15.4	10.3	9.78	66.8
842	....do	23	16.5	10.8	10.26	65.4
849	H. Buckhouse, Missoula	18	23.4	21.0	20.23	91.0
862	Bitter Root Stock Farm, Missoula	25	20.1	18.8	17.86	93.5
875	J. W. Strevell, Miles City	38¾	25.1	20.6	19.57	82.0
876	....do	38½	24.1	20.2	19.19	83.4

NEBRASKA.

Report by T. L. LYON, acting director of the State Experiment Station, Lincoln, Nebr., March 19, 1900.

The year 1899 was not a very favorable one for beet growing in this State, owing to a variety of causes; the rainfall was very unequally distributed, and at some places was excessive, as, for instance, on the experiment-station beet field, while in other portions of the State there was not sufficient moisture. The leaf-spot disease, the web worm, and the fall army worm did much damage through the past summer. The analytical results of last year's experiments are very voluminous and it would not be possible for us to send these without incurring a very considerable expense in copying. We made last year about 30,000 analyses, of which 588 were of beets from different portions of the State. We have not yet been able to arrange these by counties or even to strike an average for the State. The beets raised by this station for experimental purposes average about 11½ tons to the acre, with a sugar content of about 12½ per cent, and a purity coefficient of 79. I would say, however, that our beets suffered greatly last year from excess of moisture, and from the leaf-spot disease. A 500-ton factory was built at Ames by the Standard Beet Sugar Company. Omaha is endeavoring to arrange for a factory to be built there this year, with some likelihood of success. It is very likely that the Ames factory will be increased to 1,000 tons capacity in the near future. There is no bounty paid in this State at this time.

NEVADA.

Report by Prof. N. E. WILSON, Chemist of the State Experiment Station, Reno, Nev.

The following table shows the results of experiments in growing sugar beets in this State for analysis at this station from the beginning of the present decade down to the close of 1898. The data are arranged by counties and by seasons. It will be noticed that under some of the counties given in the table no record appears for

some seasons. This results from the fact that no samples of beets were sent in for analysis from those counties for those years:

Average results of analyses of sugar beets grown in Nevada, 1891–1898, by counties.

County and season.	Per cent of sucrose in the juice.	Per cent of sucrose in the beets.	Coefficient of purity.	Number of samples.
Washoe:				
1891	15.29	14.52	84.08	106
1892	17.93	16.33	86.65	164
1893	20.58	19.55	87.27	10
1894	13.24	12.58	79.34	130
1895	13.74	13.05	76.85	10
1896	15.20	14.54	.....	6
1897	19.96	18.72	.....	9
1898	18.72	17.78	85.35	16
Douglas:				
1891	12.20	11.59	78.35	33
1892	13.70	13.02	86.70	6
1898	17.45	16.57	67.25	3
Lander:				
1891	14.12	13.41	79.50	13
1897	15	14.25	.....	1
Lyon:				
1891	11.16	10.60	77.23	21
1892	9.75	9.26	73.77	2
1894	14.86	14.12	69.80	17
1897	19.30	18.34	.....	1
Humboldt:				
1891	14.73	14	82.51	12
1893	10.43	9.91	66.58	38
1895	14.22	13.51	72.58	7
1896	8.02	7.62	.....	5
1897	17.68	16.80	.....	5
1898	.....	.....	.....	.....
Elko:				
1891	15.48	14.71	80.05	6
1892	17.80	16.91	89.55	3
1893	16.07	15.26	86.41	7
Churchill:				
1891	16.49	15.66	82.85	8
1898	13.14	12.67	78.57	3
Storey: 1891	9.93	9.44	69.88	3
Eureka: 1892	11.85	11.26	76.43	24
Nye: 1892	13.67	12.98	85.63	6
Lincoln: 1892	15.67	14.89	86.67	3
White Pine:				
1897	14.70	13.97	.....	1
1898	16.31	15.48	.....	3
Esmeralda: 1897	17	16.17	.....	1
Scattering: 1892	16.60	15.77	87.45	12

NEW MEXICO.

Report by Prof. ARTHUR GOSS, Director of the State Experiment Station, Mesilla Park, N. Mex., March 20, 1900.

In the sections of the Territory covered, excellent results were secured in the sugar-beet work here last year (1899). Fewer samples were analyzed than in the two years previous, the principal object being to check the results from a few localities in the Territory where the best results had been secured during 1897–1898. The figures for 1899 entirely confirm the results of the two previous seasons. There are several sections, especially in the northern portion of the Territory, that can undoubtedly produce remarkably high-grade beets. This is especially true of the locality around Santa Fe, in Santa Fe County, and the Animas Valley, in San Juan County. The average results from these two places for the past three years are as follows:

Average results from Santa Fe and San Juan counties for 1897, 1898, and 1899

County.	Year.	Number of samples.	Weight of beets (pounds).	Per cent sugar in beet.	Purity coefficient.
Santa Fe	1897	24	1.66	14.33	79.6
	1898	10	1.10	17.76	82.1
	1899	4	.70	18.15	82.5
San Juan	1897	14	2	15.64	81.3
	1898	10	1.20	16.77	88.4
	1899	8	1.47	17.25	81.2

The results of analyses of beets grown in New Mexico in 1899 are given in the following table:

Average results for New Mexico in 1899, by counties.

County.	Number of samples.	Weight of beets (pounds).	Per cent of sugar in beet.	Purity coefficient.
San Juan	8	1.47	17.25	81.2
Mora	2	1.34	15.53	88.8
Santa Fe	4	.70	18.15	82.5
San Miguel	1	1.25	13.78	76.3
Bernalillo	1	.69	11.88	76.7
Socorro	1	1	10.83	65.1
Average for the Territory	17	1.19	16.36	80.9

No factories were built in the Territory last year, but several places in the Territory have been trying to secure factories. The most persistent effort, perhaps, and probably with the best chance of success in the near future, has been made by the Santa Fe people.

The Territory pays no bounty on sugar.

NEW YORK.

Report by J. L. STONE, in charge of beet-sugar investigations of the State Experimenting Station, Ithaca, N. Y., April 30, 1900.

Replying to your inquiries relating to the sugar-beet industry in New York State, I will say that the last season was only fairly successful. The spring conditions were unusually favorable over most of the State. The seeds were planted in good season, and with the soil in fine condition. The weather was unusually favorable for getting the crop up and thinned at small expense, and until August the prospects for a good crop were flattering. From August on, one of the most destructive droughts on record prevailed over much of the State, and the yield of beets was very materially reduced. Owing, however, to the good start the crop had received, the average yield did not fall below that of some other seasons. Doubtless the average cost of producing the crop was lower than ever before, for most of the growers had had one or two years' experience with the crop, and the early season favored getting it in fine shape at little cost. It is therefore to be presumed that from a financial standpoint the result to the farmers was even more satisfactory than in previous seasons.

The following table, while not including all the analyses made at this station during the last season, will, I think, answer your questions as satisfactorily as any data I can give. The "yields per acre" are the average results obtained on 19 farms, and the "sugar in beets" and "purity of juice" on 24 farms, each growing the five varieties side by side, except that the last-named variety was not reported from two of them.

Comparison of average results, 1899.

Varieties of beets grown.	Yields per acre.	Per cent of sugar in beets.	Coefficients of purity.	Sugar produced per acre.
	Tons.			*Pounds.*
Kleinwanzlebener	11.67	15.16	81.2	3,538
Vilmorin	11.14	14.07	79.9	3,235
Zehringen	11.10	15.65	81.8	3,474
Mangold	12.20	15.01	81.3	3,662
Biendorf Elite Kleinwanzlebener	11.30	14.19	79.2	3,207
General average, all varieties	11.48	14.82	80.7	

For further data regarding the results in this State I refer you to bulletins 143 and 166 which I forward under separate cover. You will find the general conclusions stated in the latter on pages 427, 431, and 455.

No new factories were built in New York last season, and there is only one, I think, now building, that of Lyons, in Wayne County. A number of places have agitated for factories, but I am not aware of any where a factory is assured. The climate and much of the soil of New York seem to be well adapted to the growing of sugar beets, but the farmers seem slow to take hold of the industry. One possible explanation is that in recent years tobacco, cabbage, potatoes, and products for the canning factories have paid quite well and the farmers prefer to stick to crops with which they are familiar rather than to risk new ones.

The State pays a bounty of 1 cent per pound for the finished product made from beets grown in the State for which the farmers have received at least $5 per ton.

The following extracts from bulletin No. 166 of the State station show the cost of producing sugar beets in the season of 1898 and average results of analyses for 1897 and 1898:

COST OF GROWING SUGAR BEETS.

One hundred and fifty-two farmers planted 252 acres of beets and harvested an average of 14 tons of trimmed beets per acre. Arrangements were made with more than 100 farmers to keep careful records of the number of hours of labor of teams, men, or boys employed in growing their fields of beets. Blanks were furnished for keeping the data and making reports. They were instructed to charge up this labor at the usual price in their localities. Only 45 reports complete in this respect have been received. The figures given do not include the cost of seed, fertilizer, or the use of land. Of the 45 farmers—

4 report the cost as less than $25 per acre.
6 report the cost as between $25 and $30 per acre.
12 report the cost as between $30 and $35 per acre.
7 report the cost as between $35 and $40 per acre.
3 report the cost as between $40 and $45 per acre.
1 reports the cost as between $45 and $50 per acre.
4 report the cost as between $50 and $55 per acre.
2 report the cost as between $55 and $60 per acre.
5 report the cost as over $60 per acre.

The lowest cost reported is $10.20 per acre, the highest $83, and the average $38.15. Of the 43 reports in which the cost per ton is given—

9 place the cost below $2 per ton.
15 place the cost between $2 and $3 per ton.
10 place the cost between $3 and $4 per ton.
5 place the cost between $4 and $5 per ton.
4 place the cost above $5 per ton.

The lowest cost is $1.41, the highest $7.52, and the average $3.25 per ton.

Results of analyses of beets produced in New York, 1897 and 1898.

	Season 1897—average of 495 samples.		Season 1898—average of 496 samples.
Per cent solids in juice	20.75	Per cent solids in juice	18.30
Per cent sugar in juice	16.91	Per cent sugar in juice	15.29
Per cent sugar in beet	16.06	Per cent sugar in beet	14.53
Coefficient of purity	83.50	Coefficient of purity	83.60

A comparison of these two seasons suggests the query, why so much difference in the two cases? Why are the beets so much richer in sugar one year than they are another year? Several causes suggest themselves for this. There is a possibility that the quality of the seed this year was not quite so good as that of a year ago. This season a few new varieties were tried and some of them were of a poor quality and hence tended to lower the general averages of the season's work. The temperature of the two seasons varied somewhat and this probably has been an important factor influencing the amount of sugar produced in the beets.

It is thought that the one condition that had most to do with the decrease of sugar in 1898 was the difference in the amount of moisture.

NORTH DAKOTA.

Report by E. F. Ladd, Chemist of the State Agricultural College, Fargo, N. Dak., March 13, 1900.

The experiments for the year 1899 in sugar-beet growing in this State were not wholly satisfactory. The season was not well adapted for high sugar content, but I inclose a copy of my report for all samples that were analyzed, just as the same will appear in the forthcoming annual report for the station.

I am not able to arrange the data as you request by counties, but have them arranged for the three varieties which were experimented with. As to the yield per acre, I have found this very difficult to determine from the reports of farmers seeding on such a small portion of ground, and therefore I made no estimate for the past year, as I did not consider the results reliable. In 1892, in bulletin No. 5, copy of which I send, some estimate was made from the data for that year. I do not consider the results for sugar beets grown upon the station farm here as giving anything sufficiently accurate on which to base a judgment. This soil does not seem at all adapted for either a large yield or high sugar content.

No factories have been built in this State. There has been some discussion by parties in regard to locating factories in various parts of the State, but nothing has yet been done that would indicate the likelihood of a factory during the next year or two. I believe, however, that the southern and western part of this State is well adapted for producing sugar beets of a high content and of sufficient purity to make a factory profitable in the vicinity of Oakes, in Dickey County.

The seed furnished by the Department of Agriculture was of three varieties, Vilmorin's Improved White (2378), Gehringen (2379), and Mangold (2884).

The following table shows the maximum, minimum, and average for each of these varieties and number of samples tested:

Results in North Dakota in 1899.

Item.	Vilmorin's.	Zehringen.	Mangold.
Number of samples	11	12	64
Maximum sugar content.....per cent..	15.64	15.90	17.94
Minimum sugar content.....do....	11.50	10.24	7.70
Mean sugar content.....do....	13.96	12.55	12.85
Coefficient of purity	82	81	79

The year has been generally unfavorable and farmers, in sending in their reports, state quite generally that the season was not favorable for best results. Again, often the ground was not properly prepared nor the beets well cared for during the summer.

OHIO.

Report by CHAS. E. THORNE, Director of the State Experiment Station, Wooster, Ohio, March 13, 1900.

In Ohio with our late planting, and especially upon the silty soils at the experiment station at Wooster, it has been almost beyond our power to obtain a fair stand of sugar beets in any season. For this reason we are now distributing beet seed for next year's experiments, 900 pounds in all, and urging that the planting be done early the present season, say in March or early April, in order to avoid the baking effects of the hot sun later.

The stand of beets secured by experiments in Ohio in 1899 was very poor. While the yields of beets were correspondingly poor, the sugar content was good and the purity better than any before obtained in the cooperative experiments in this State. The summary of last year's experiments by counties and by sections, with a general analytical summary of the results of the last three years compared, are inclosed herewith.

The only careful work that has been done at any time as to the yield of sugar beets was done in 1898 and published in our Bulletin 99 herewith mailed you. It will answer the question as to yield so far as it can be answered, and further data by counties for the last three years are included in the inclosed paper and Bulletins 90 and 99.

You will perceive that there has been a constant reduction in the size of sample beets, and, under favorable weather conditions, an increase in the purity of the beets.

No beet-sugar factories were built in Ohio last year. I am informed that the Continental Beet Sugar Company has broken ground for a factory at Fremont, Sandusky County. Of this company it is stated that Mr. G. E. Collings, of Cleveland, is president, and Mr. E. H. Dyer, of Cleveland, secretary. There have been preparations on foot for a factory at Osborn, Greene County; at Coldwater, Mercer County, and at Deshler, Henry County. Mr. R. R. Dickey, of Dayton, is at the head of the Osborn enterprise. I am not informed as to who are the promoters of the other proposed factories. It seems probable that the next factory to be considered in Ohio, aside from the one at Fremont, will be located in northwestern Ohio, in the vicinity of Toledo.

No bounty is paid by the State of Ohio on the manufactured sugar.

The following tables are from the publications forwarded:

Summary of analyses of beets grown in Ohio in 1899.

County.	Number of samples.	Average weight of beets.	Sugar (sucrose) in beets.	Purity coefficient.
		Ounces.	*Per cent.*	
Adams	1	20.0	13.9	78.9
Allen	1	35.0	16.5	90.4
Ashtabula	3	20.1	13.6	81.4
Champaign	2	12.0	13.8	77.6
Clermont	1	22.0	10.7	73.8
Clinton	2	29.0	11.1	75.0
Columbiana	3	17.4	12.8	80.3
Defiance	4	18.7	12.4	78.8
Erie	2	21.5	10.1	72.3
Franklin	3	8.7	12.3	76.4
Fulton	9	28.6	12.0	79.2
Geauga	5	24.0	13.0	78.1
Greene	7	21.6	12.1	77.5
Hancock	4	16.1	15.0	84.5
Hardin	4	24.5	12.5	79.5
Highland	2	24.5	8.9	66.2

Summary of analyses of beets grown in Ohio in 1899—Continued.

County.	Number of samples.	Average weight of beets.	Sugar (sucrose) in beets.	Purity coefficient.
		Ounces.	*Per cent.*	
Holmes	1	28.0	14.5	77.3
Lake	3	18.7	13.6	81.2
Lucas	15	23.5	12.8	82.8
Marion	1	24.0	12.8	82.8
Medina	1	51.0	13.9	77.6
Mercer	4	44.5	10.8	75.5
Montgomery	7	19.0	13.1	80.7
Muskingum	3	23.5	9.8	76.3
Ottawa	1	19.0	12.3	78.3
Paulding	2	29.5	14.2	86.0
Putnam	1	35.0	14.1	88.1
Sandusky	4	19.0	13.9	82.0
Seneca	1	23.0	14.0	81.7
Stark	1	26.0	15.2	82.0
Summit	7	12.8	13.1	83.1
Van Wert	1	28.4	9.2	70.8
Wayne	24	13.1	12.9	82.4
Wood	1	36.0	11.7	74.1

Summary of analyses of beets grown in Ohio in 1898.

Ashland	2	12.0	12.5	81.1
Ashtabula	11	16.7	12.2	79.7
Auglaize	2	25.0	10.6	77.9
Brown	2	19.5	10.4	80.1
Champaign	22	17.4	10.5	76.9
Clarke	29	18.8	12.2	77.9
Clermont	8	18.6	11.3	77.7
Clinton	1	37.0	7.4	65.0
Columbiana	2	19.0	13.2	80.4
Coshocton	3	22.7	10.0	76.3
Crawford	7	28.4	11.4	78.6
Darke	4	15.5	9.7	75.8
Defiance	2	14.5	12.0	81.4
Delaware	3	19.3	11.1	78.8
Erie	26	22.0	12.0	80.5
Fairfield	2	12.5	12.2	78.8
Fayette	2	46.0	10.3	75.9
Franklin	10	21.0	11.2	76.5
Fulton	25	22.4	13.1	83.0
Geauga	2	27.0	11.3	79.0
Greene	12	20.0	9.7	74.2
Guernsey	2	20.0	11.3	77.7
Hancock	12	20.4	10.9	78.7
Hardin	5	29.4	11.9	78.9
Henry	15	26.7	11.5	79.6
Highland	13	8.9	11.7	78.6
Holmes	2	15.5	7.7	73.5
Knox	16	17.2	11.0	78.6
Lake	5	12.2	13.1	82.4
Logan	6	16.0	10.9	77.6
Lorain	2	19.5	9.5	71.4
Lucas	17	32.4	12.7	81.7
Madison	3	20.3	9.9	75.3
Mahoning	1	14.0	10.8	78.6
Marion	5	30.2	10.3	74.6
Medina	3	13.3	12.2	78.8
Mercer	13	33.0	10.8	74.3
Miami	12	24.4	12.3	81.5
Montgomery	3	21.0	10.8	78.6
Morgan	3	26.0	11.3	74.1
Morrow	2	11.0	11.5	77.1
Muskingum	4	17.2	9.4	73.0
Noble	1	23.0	8.1	71.5
Ottawa	59	28.8	11.5	77.0
Paulding	3	19.3	11.7	77.7
Perry	2	22.5	11.3	80.2
Pickaway	1	16.0	8.3	75.0
Portage	4	15.7	12.2	81.5
Preble	2	23.5	10.6	78.1
Putnam	4	33.5	10.6	78.7
Richland	1	31.0	9.1	72.2
Sandusky	14	31.8	10.0	75.5
Seneca	14	34.2	10.4	77.4
Shelby	2	24.0	11.2	78.1

Summary of analyses of beets grown in Ohio in 1898—Continued.

County.	Number of samples.	Average weight of beets.	Sugar (sucrose) in beets.	Purity coefficient.
		Ounces.	*Per cent.*	
Stark	2	15.0	13.0	80.1
Summit	10	30.6	10.3	77.3
Tuscarawas	3	24.3	10.6	74.5
Union	1	7.0	10.2	74.3
Van Wert	8	22.8	11.4	77.7
Wayne	35	18.6	11.8	81.7
Williams	1	48.0	12.4	81.8
Wood	4	33.0	12.6	81.3
Southern section	51	18.4	10.9	76.9
Middle section	153	19.6	11.1	76.9
Northern section	294	25.0	11.6	78.7
Entire State	498	22.7	11.4	77.9

Comparison of general results for 1897 and 1898.

Section.	Number of samples.		Average weight of beets.		Sugar in beet.		Purity coefficient.	
	1897.	1898.	1897.	1898.	1897.	1898.	1897.	1898.
			Ounces.	*Ounces.*	*Per ct.*	*Per ct.*		
Southern section	67	51	31.4	18.4	12.2	10.9	75.3	76.9
Middle section	132	153	32.6	19.6	13.2	11.1	78.0	76.9
Northern section	355	294	29.2	25.0	13.6	11.6	79.4	78.7
Whole State	554	498	30.6	22.7	13.3	11.4	78.7	77.9

OKLAHOMA.

Report of JOHN FIELDS, Director of Experiment Station, Stillwater, Okla., March 19, 1900.

The reports which have already been made concerning sugar-beet growing here cover all that has been done. We did no work in 1899. The results have been such as to indicate very strongly the futility of attempting to grow beets for sugar here. No factories were built last year, none will be built this year, and none should be built in the future. No bounty is paid on the manufacture of sugar.

OREGON.

Report by Prof. G. W. SHAW, Chemist of the State Experiment Station, Corvallis, Oreg.

For consideration of results it has been the custom in former publications to divide the State into three divisions, eastern, western, and southern Oregon, on account of the wide difference in climatic and soil conditions, and the same plan will be followed in this case.

Details and individual analyses are omitted from this publication, averages only being given.

EXPERIMENTS IN EASTERN OREGON.

UNION COUNTY.—No extensive experiments in the growth of beets were conducted in this county inasmuch as previous results had conclusively demonstrated the Grande Ronde Valley to be particularly well adapted to the production of beets for sugar, as a result of which there had already been erected the first sugar factory in the State.

The people of La Grande, and indeed of the entire State, have much to congratulate themselves for as the industry is one of the most important in the Northwest and is bound to be successful. The percentages obtained the first season were exceptionally high both in sugar content and purity. The factory books show the percentage of sugar to have been 15.6 for the entire crop and the coefficient of purity 84.6, which is, so far as I am able to ascertain, higher than any first-year results obtained elsewhere. The present season the tonnage was more nearly normal, although not so high in general as I think it will finally be for that region; the cultivation cost less than in the first season, because the farmers understood the habits of the beet better; and the sugar content and purity were both excellent. The average results for beets delivered to the factory to October 25 were 15 per cent of sugar and a purity coefficient of 82.

Results of variety tests, 1899.

Variety.	Number of samples.	Weight of beets, grams.	Per cent of sugar in juice.	Coefficient of purity.
Vilmorin Improved (Russian grown)	9	431	15.7	86
Kleinwanzlebener (grown by Vilmorin)	12	275	16.7	86
Zeringen (grown by Strandes)	12	358	16.8	86
Vilmorin French, very rich	12	370	15.8	85
Pitzschke's Elite	9	359	15.9	84
Seed from factory (original Kleinwanzlebener)	12	459	18.1	86
Schreiber's Elite	12	303	17.5	87

Reviewing the results of 18 other analyses, the range was from 10.4 per cent sugar in the juice, with a purity coefficient of 69.7, in a beet weighing 553 grams (19.4 oz.), to a maximum of 21.3 per cent of sugar in the juice, with a purity coefficient of 90 per cent, in a beet weighing 406 grams (12.2 oz.). The average for the county was: Sugar in juice 15.8 per cent, coefficient of purity 83.2, and weight 446 grams (13.4 oz.).

MALHEUR COUNTY.—Twelve samples were analyzed during the season, with the following results:

Beets showing—

14 to 15 per cent sugar in juice 1
15 to 16 per cent sugar in juice 3
16 to 17 per cent sugar in juice 2
17 to 18 per cent sugar in juice 2
18 to 20 per cent sugar in juice 4

The average results of the analyses of beets produced in Utah in 1891, 1897, 1898, and 1899 are given in the following table:

Average results of analyses, by years.

Time of analyses.	Number of analyses.	Weight of beets.	Per cent of sugar in juice.	Coefficient of purity.
		Ounces.		
1891-92	1	.....	20.20	84.9
1897-98, by station	12	18	17.17	90.8
1897-98, by Utah Sugar Company	15	20	16.10	84.1
1898-99, by station	12	17	16.9	87.1

There is plenty of land suitable for beet culture in this region, and were it not for the fact of a sparse population it would be a most excellent point for the location of a factory. Unless a larger population can be brought here, beet culture will be out of the question. If this difficulty could be overcome there would be no better place in the State for a factory. There is abundance of water and land, it is near excellent lime quarries, and fuel can be readily obtained.

WESTERN OREGON.

Many beets were analyzed from western Oregon, mainly from the Willamette Valley. The results are given below. These are classified by counties and show the average for each county:

Average results in western Oregon for 1899.

County	Number of analyses.	Weight of beets, grams.	Per cent of sugar in juice.	Coefficient of purity.
Benton	3	691	13	82.9
Clackamas	9	390	17	86.8
Coos	1	545	13.8	85.7
Douglas	15	852	14.8	86.2
Lane	12	474	14.9	86.1
Lincoln	7	604	14.6	86.9
Linn	21	554	14.5	88.3
Marion	6	703	14	82.9
Multnomah	10	556	14.8	86.6
Polk	2	595	11.8	84.3
Tillamook	3	377	17.3	90.6
Washington	4	413	15.3	87.6
Yamhill	12	564	14.3	82.2

Of the 105 analyses reported for western Oregon, 97 show above 12 per cent sugar in the juice, 74 above 14 per cent, and 35 above 16 per cent. The average of all analyses for the season for western Oregon was, 14.8 per cent sugar in juice, purity coefficient 85, weight of beets 425 grams (14.87 oz.). Results obtained other years are as follows:

Average results in western Oregon in former years.

Year.	Number of analyses.	Per cent of sugar in juice.	Coefficient of purity.
Season of—			
1891	81	13.7	77.9
1892	41	14.7	81.7
1897	115	15.1	85.6
1898	105	14.8	85

The Willamette Valley is much handicapped by having a soil which is generally too clay-like for beet production for sugar purposes. Rains also are very likely to occur just about the time beets mature, thus rendering a successful harvest very uncertain. Beets grown in the soils of Willamette Valley have a great tendency to throw out many root hairs and branching roots, even with good cultivation. This, in addition to the sticky nature of the soil, would render it almost impossible to properly wash beets delivered at the factory. These facts, taken together with that of lack of a cheap lime supply, enforce the conviction that it is not wise to advocate the establishing of sugar factories in this portion of the State.

SOUTHERN OREGON.

JACKSON COUNTY.—Forty-six samples were analyzed from this county. The results ranged from 10.9 per cent sugar in the juice, with a purity coefficient of 69.4 to 20.2 per cent sugar in juice, with a purity coefficient of 86. The weight of beets ranged from 9.5 ounces to 54 ounces. The beet giving the lowest results, however, could not be considered mature. Of the 46 analyses made, 40 showed over 12 per cent of sugar in the juice, 23 showed over 15 per cent, 21 showed over 16 per cent, and 14 over 17 per cent. The average for the county was 15.8 per cent sugar in juice, with a purity coefficient of 83.8; weight, 547 grams (19.1 oz.).

The following table shows the average results obtained from analysis of beets produced in this county in former years:

Average results obtained in Jackson County in former years.

Year.	Number of samples.	Average weight.	Per cent of sugar in juice.	Coefficient of purity.
		Grams.		
1891	3	275	18.9	80.99
1892	1	783	15	84.74
1897	60	437	15.4	81
1898	46	546	15.8	83.80

When these results are considered in connection with the fact that all the conditions for maintaining a factory exist in the immediate vicinity, as shown in Bulletin 53, I feel confident that there is no better location for a factory to be found than exists in Jackson County. The people of that section of the State should recognize the importance of this great industry and take steps toward securing the location of a sugar factory in their midst.

No factories were erected in the State last year. Newberg is arranging for the erection of a factory next year. Medford is hoping to interest capital in a most excellent locality. The State pays no bounty.

PENNSYLVANIA.

Report by Prof. HENRY P. ARMSBY, Director of State Experiment Station, State College, Pa., March 13, 1900.

I take pleasure in forwarding you, under another cover, copy of our latest bulletin upon the growing of sugar beets in this State, giving the results for 1899, averaged by counties. I do not know of any factories having been built in the State last year nor that any are in contemplation in the near future. This State pays no bounty on the manufacture of sugar.

The following table shows the number of samples received from each of thirty-three counties, and the average results for each county:

Summary of results by counties for 1899.

No.	County.	Yield per acre, tons.	Average weight of beets.	Per cent of sugar in beet.	Coefficient of purity.	Number of tests.
1	Adams	7.50	.....	12.91	81.4	67
2	Armstrong	19.16	1.56	12.05	80.3	4
3	Beaver	18.16	1.66	8.3	71.3	1
4	Berks	.....	.....	11.83	74.7	1
5	Bradford	13.57	1.02	13.33	82.1	5
6	Bucks	25.18	1.50	12.32	82.6	5
7	Center	4.68	.39	14.22	90.9	6
8	Chester	21.13	3.46	11.23	75	2
9	Cumberland	9.24	.....	12.08	82	236
10	Crawford	25.35	1.5	13.32	80.4	9
11	Columbia	.....	.....	12.77	79.8	1
12	Dauphin	.....	.....	11.42	84.4	2
13	Erie	23.85	1.13	14.35	84.7	3
14	Franklin	8.74	.....	12.47	80.3	71
15	Fulton	.....	.....	12.3	81	2
16	Jefferson	35.24	1.68	12.53	81.4	11
17	Lawrence	9.08	1.37	13.68	89.4	1
18	Lancaster	14.43	.94	10.85	80.2	15
19	Lebanon	5.18	1.78	13.82	78.8	1
20	Luzerne	31.40	1.17	13.18	84.45	7
21	Lycoming	.....	.....	14.63	87	2
22	Montgomery	21.28	2.26	9.17	74.1	1
23	Northampton	12.96	1.98	9.36	70	13
24	Perry	5.01	.....	13.17	82.2	1
25	Potter	14.97	1.05	13.83	83.3	2

Summary of results by counties for 1899—Continued.

No.	County.	Yield per acre, tons.	Average weight of beets.	Per cent of sugar in beet.	Coefficient of purity.	Number of tests.
26	Susquehanna	17.23	.52	13.7	77.7	1
27	Schuylkill	6.55	.18	15.05	95.1	2
28	Tioga	28.60	1.19	14.06	83.9	1
29	Union	6.05	.44	11.12	73.6	1
30	Venango	6.34	1.09	15.19	98.1	1
31	Warren	.....	.....	15.43	88	1
32	Westmoreland	.....	.....	11.54	77.5	2
33	York	.....	.....	12.81	83.7	.....
	State average	15.63	1.33	12.66	81.8	

Undoubtedly there are many instances in which the beets were harvested too early to give the best results as to quality. This applies especially to Adams, Franklin, and Cumberland counties.

The only decidedly adverse results were obtained in Lancaster and Northampton counties, and in the case of the former it should be noted that the results differ materially from those of 1897.

SOUTH DAKOTA.

Report of Prof. J. H. SHEPARD, Director of State Experiment Station, Brookings, S. Dak., March 10, 1900.

The station has discontinued experimenting, believing that we have proven the proposition that sugar beets will do very well indeed in this State. I have no further reports to make you, but thinking that perhaps you might not have our bulletins at hand, I have made a collection of those on sugar beets, which I forward you.

The following quotations from the bulletin for 1899 cover the results of the year's experiments in South Dakota:

It was deemed best to confine the work to a few localities rather than to send the seed promiscuously over the State. Preferably those localities were selected which had been making efforts toward securing sugar factories.

In pursuance of this policy five points were selected, viz: Aberdeen, Huron, Yankton, Sioux Falls, and Brookings. Committees were selected in each locality and advised to organize and to make united efforts to obtain the commercial data required. In each place the committee elected a president and secretary and entered upon the work with hearty good will.

The instructions sent out were quite full and complete, varying but little from those issued in previous years. It was urged upon the committee, however, that the seed should be sown thickly, in rows 20 inches wide, and the beets were to be thinned to a distance of from 6 to 8 inches in the row.

Taking all things into consideration, it would seem, then, that we have reached the limits of useful experimentation. The samples received at the station this year were more satisfactory than those received in previous years. In fact, in one or two instances only were parties requested to send a second sample. There is one thing concerning the sampling which should be taken into consideration, and that is, the selections were not made by experts, but by the farmers themselves, who certainly had no means of judging their richness and fitness for sugar-making purposes.

Summary of results from the five experiment localities.

ABERDEEN.

Name of grower.	Per cent of sugar.	Coefficient of purity.	Tons per acre.	Cost per acre.
Thos. E. Williams	20.70	92.05	14.00	$25.95
Robert Owen	19.10	93.17	12.40	28.30
J. E. Hickenbotham	16.70	93.30	22.40	40.70
R. S. Roe	20.60	94	18.20	38.80
Average	19.27	93.13	16.75	33.43

Summary of results from the fire experiment localities—Continued.

HURON.

Name of grower.	Per cent of sugar.	Coefficient of purity.	Tons per acre.	Cost per acre.
Smith & Miller	16.10	79.70	32.90	$41.82
Do	16.70	81.86	14.90	27.15
Do	17.30	82	12.50	20.90
Do	19.60	85.83	6.50	19.10
Do	18.40	85.98	7.08	27.70
C. A. Sauer	18.90	83.21	6.80	31.29
Average	17.83	83.09	13.44	27.99

YANKTON.

Geo. E. Whiting	20.00	91.74	9.60	$48.00
Fred Jacob	20.50	93.10	22.30	48.58
E. G. Edgerton	16.40	89.16	14.20	34.70
Torger Nelsen	19.50	90.70	11.80	34.60
Average	19.10	91.17	14.47	41.47

SIOUX FALLS.

N. E. Phillips	18.20	88.78	17.00	$35.65
John Griffiths	17.50	86.21	23.50	50.93
Average	17.85	87.49	20.25	43.29

BROOKINGS.

E. C. Chilcott	21.20	93.00	11.40	$53.77
G. W. Roe	17.90	88.74	22.50	40.25
Hogan Anderson	16.60	88.70	20.40	37.10
R. N. Crawford	16.90	88.40	12.20	37.00
Average	18.15	89.71	16.62	42.03
Average for State	18.44	88.91	16.30	37.64

UTAH.

Report of LUTHER FOSTER, Director of State Experiment Station, Logan, Utah, March 12, 1900.

The past year was the most successful with both beet growers and factory people since the industry was started in the State. The Lehi factory made a dividend of 12½ per cent, and stock was sold at 40 per cent above par. Some Ogden factory stock sold at a much higher figure. The Lehi factory with its branch plant used over 52,000 tons of beets, and the Ogden factory a proportionately large amount. The station's cooperative experiments were confined to Sanpete and Sevier counties, and the results show that beets of as good quality as those grown in the vicinity of Ogden and Lehi can be produced in that locality.

The analytical results of last year's work are contained in Bulletin No. 63, which will be forwarded.

On page 110, Bulletin No. 59, are given the results of five years' work, to which may be added those for 1899.

During the past season the Lehi factory, at an expense of about $250,000, built a branch establishment at Springville, where the juice is extracted and from there it is conveyed to their main factory by means of a pipe line. This was completed in time to handle the crop of 1899.

The same company has arranged for the building of another similar branch at Sandy, in Salt Lake County, about 10 miles from Salt Lake City. This will be completed in time to handle the crop of 1900.

As a result of experiments in Sanpete and Sevier counties, a company has been organized which proposes to have a factory ready to handle the crop of 1901. Their plan is to locate the main factory at Gunnison, a town near the junction of the Sanpete and Sevier rivers, with branch factories in each of these river valleys, at a distance of about 20 miles from the main factory. The matter of building a factory is still agitated in Cache County. Some stock has been subscribed, but not a sufficient amount to secure the assistance of outside capital. The farmers of this county are engaged in growing beets for the Ogden factory, the acreage increasing year by year.

No bounty is now paid by the State, though at one time an appropriation was made for that purpose covering a period of two seasons. There is at present no indication that the bounty will ever be renewed. The industry seems to stand on a good, solid foundation and can take care of itself.

The following is taken from the printed bulletins of the station referred to:

The cooperative experiments in sugar-beet culture for the past season were confined to the farmers of Sanpete and Sevier counties. They were carried on in conjunction with an organization formed by the citizens of the two counties and known as the Sanpete-Sevier Sugar Company. This association was organized at a delegate convention, held at Gunnison, February 17, 1899, which was composed of representatives from all of the principal settlements in the two counties. Bishop Christian A. Madsen, the chief promoter of the movement, was chosen president of the company; Mr. C. A. Short, secretary, and Mr. Thomas Kearnes, treasurer. The general plan of this organization is a systematic one, and it has proven very effective in its results. The management and direction of the experiment were vested in a central board, with headquarters at Gunnison, a centrally located town. Auxiliary organizations called sugar-beet clubs were formed at the following twenty-one principal towns of the two counties: Annabella, Aurora, Axtell, Central, Center Field, Elsinore, Fairview, Fayette, Glenwood, Gunnison, Joseph City, Manti, Mayfield, Monroe, Redmond, Richfield, Salina, Sigurd, Spring City, Sterling, and Vermilion.

Each of these local clubs was in charge of a chairman, who by virtue of such office was a member of the central board, and its membership included all the farmers in each precinct who would engage in the beet-raising experiment. The object of this company was to make a decisive test of the general adaptability of the lands of the two counties for sugar-beet culture and at the same time to show prospective factory builders that the people are awake to the importance of the new industry and will grow beets in sufficient quantity to supply a factory when opportunity offers. Averaging the results from these two counties for the past season, and using only the best from each patch, we have the following:

Results in Sanpete and Sevier counties in 1899.

County.	Average per cent of sugar in beet.	Average coefficient of purity.
Sanpete County	15.89	81.83
Sevier County	15.54	82.16
Average	15.72	82.01

The following shows the average result of the determinations made by the experiment station in each of the four counties reported in Tables I, II, and III:

Average results in four counties.

	Per cent of sugar in beet.	Coefficient of purity.
Average of—		
Utah County for 2 years	15.45	84.10
Weber County for 2 years	13.98	83.16
Sanpete County for 3 years	15.47	82.20
Sevier County for 3 years	14.92	81.58

Comparing the above results, it will be seen that in per cent of sugar the beets grown in Sanpete and Sevier counties are fully up to those produced in Utah and Weber counties, but in coefficient of purity they are a little lower, though considerably above factory requirements. There is no doubt that the farmers of these counties will grow beets of better quality after they have gained a few years' experience under expert supervision.

Average annual results of five years' experiments in Utah.

Year.	Number of samples.	Per cent of sugar in juice.	Coefficient of purity.	Per cent of sugar in beet.
1891	21	16.55	86.10	.....
1892	47	13.12	80.90	.....
1896	86	15.70	84.70	.....
1897	269	14.24	83.10	.....
1898	316	16.65	86.89	15.82
Average	739	15.43	84.85	14.66

The Utah farmer, as a rule, owns but a small piece of land, ranging from 5 to 40 acres. Since successful beet culture requires intensive farming, these small holdings are exactly suited to the work. There are few other crops for which the control of the water supply is so important. The maturity, and hence quality of the crop, must depend largely on having plenty of moisture at the right time for growth and then having it withheld at a suitable season to insure no loss from the second growth so often induced by fall rains in a humid climate, and to give ample time for complete maturity. Under a system of irrigation like Utah's, not only perfect maturity is obtained, but more time may be secured for the harvest, making it possible to handle a greater acreage without additional help. Beets and other root crops endure, in our dry soils, a degree of cold that would prove destructive in a moist climate.

WISCONSIN.

Report of Prof. F. W. Woll, Chemist of the State Experiment Station, Madison, Wis., March 20, 1900.

I submit the following report of the results of our investigations in the culture of sugar beets in this State during the past year, with a summary of the results obtained during the years 1890–1899.

As in previous years, the culture trials with sugar beets in 1899 were conducted at our experiment station farm, and by farmers located in different parts of the State, the latter receiving sugar-beet seed from us in the spring and sending beets grown from this seed to us in the fall for analysis. The effort was made last year to secure the cooperation of a number of careful, interested farmers in parts of the State where rich sugar beets have been grown in previous years. Miscellaneous applicants were furnished with seeds only upon request. The average results of the analyses of the beets received from Wisconsin farmers last year are given in the following table, the results being arranged by counties:

Average results of sugar-beet analyses in Wisconsin, 1899, by counties.

County.	Number of samples.	Size of topped beets.	Sugar in juice.	Coefficient of purity.	Yield per acre.[1]
		Pounds.	*Per cent.*		*Tons.*
Adams	1	1.1	15.66	83.2	10.0
Barron	1	1.0	14.91	80.5	.....
Brown	13	1.5	14.44	80.8	15.0 (6)
Buffalo	2	1.5	16.74	86.1	20.0 (2)
Burnett	1	.7	18.85	83.6	11.5
Calumet	4	1.3	13.60	75.0	20.0 (2)
Chippewa	1	.8	15.01	79.1	.....

[1] Under yield per acre, the figures inclosed in parentheses show the number of correspondents from whose reports the figures are derived. It will be observed that comparatively few reported on yield.

Average results of sugar-beet analyses in Wisconsin, 1899, by counties—Continued.

County.	Number of samples.	Size of topped beets.	Sugar in juice.	Coefficient of purity.	Yield per acre.[1]
		Pounds.	*Per cent.*		*Tons.*
Clark	2	1.2	14.11	78.6	7.0 (1)
Columbia	4	1.3	13.09	6.7	12.2 (1)
Crawford	5	1.4	13.16	80.4	15.1 (2)
Dane	11	1.2	14.21	77.4	21.8 (2)
Dodge	2	1.2	15.35	80.9	15.6 (1)
Door	1	1.8	16.48	83.0	13.8
Douglas	1	.6	15.93	86.4	.....
Dunn	4	1.3	13.60	77.7	24.0 (2)
Fond du Lac	1	1.2	12.12	75.1	.....
Green	1	1.4	9.46	69.7	24.0
Green Lake	1	1.4	14.62	82.2	.....
Jackson	3	.8	16.51	86.4	.....
Jefferson	4	1.5	14.22	79.5	.....
Juneau	1	3.2	14.35	83.4	.....
Kenosha	2	1.0	15.78	81.4	25.2 (1)
Kewaunee	8	1.5	15.50	79.8	10.3 (1)
Lacrosse	2	1.0	13.81	77.0	14.0 (1)
Lafayette	1	1.3	14.59	74.2	.....
Lincoln	1	.9	16.48	84.6	.....
Manitowoc	5	1.3	15.17	82.5	13.0 (1)
Marathon	5	.8	14.46	81.8	.....
Marinette	2	2.1	13.42	78.1	.....
Marquette	4	1.0	15.73	80.7	16.5 (1)
Milwaukee	1	.8	19.78	87.8	.....
Monroe	3	1.3	14.24	77.8	.....
Oconto	6	1.5	14.09	81.7	[illegible]
Oneida	1	1.4	13.63	76.9	15.0
Outagamie	8	1.4	15.63	83.0	22.0 (1)
Ozaukee	1	2.0	14.34	82.4	.....
Pepin	1	1.0	19.60	83.5	.....
Polk	3	1.4	14.45	83.1	10.0 (1)
Portage	2	1.7	13.16	80.5	.....
Price	2	1.5	13.64	77.0	.....
Racine	2	1.9	15.23	79.5	.....
Rock	3	1.0	15.73	79.1	.....
St. Croix	3	1.2	13.25	76.9	.....
Sauk	7	1.0	15.15	79.1	11.0 (1)
Shawano	1	.9	17.33	85.4	.....
Sheboygan	1	2.0	18.09	84.7	.....
Taylor	1	1.0	15.40	80.2	.....
Vilas	1	1.4	16.85	85.4	.....
Walworth	2	1.6	13.42	76.9	16.5 (1)
Washburn	2	1.9	13.05	77.6	20.0 (1)
Washington	2	2.1	17.50	84.7	.....
Waukesha	7	1.3	16.09	84.3	15.7 (2)
Waupaca	9	1.7	13.80	79.3	12.0 (1)
Waushara	7	1.1	15.90	83.1	16.2 (1)
Winnebago	2	2.2	14.04	80.1	.....
Wood	1	1.7	12.57	74.4	.....
Unidentified	5	.9	14.25	75.4	.....
Total	178	.....	.....	.....	.....

[1] Under yield per acre, the figures inclosed in parentheses show the number of correspondents from whose reports the figures are derived. It will be observed that comparatively few reported on yield.

The sugar-beet investigations were begun at our station in 1890, and continued during 1891, 1892, 1897, 1898, and 1899. The work has been in charge of the writer since the beginning. I have made the compilation shown in the table of the results obtained during these six years, arranged by counties. In each case the number of years during which beets have been received from the various counties is given; also the total number of samples received, and the average results of the examinations of the beets. In calculating these results the arithmetical means of the averages for each year have been calculated, as it was believed that a more correct expression would be obtained in this manner for the average quality of beets grown in each particular county.

Average results of sugar-beet analyses in Wisconsin, 1890–1899, by counties.

County.	No. of years.	No. of samples.	Size of topped beets.	Sugar in juice.	Coefficient of purity.	Yield per acre.
			Pounds.	*Per cent.*		*Tons.*
Adams	3	11	1.4	13.92	78.6	9.7
Ashland	2	7	1.5	13.91	77.6	.....
Barron	4	25	1.3	13.71	78.0	11.6
Bayfield	1	1	2.3	10.96	73.5	16.5
Brown	4	130	2.1	13.29	77.9	15.7
Buffalo	5	19	1.6	13.64	78.3	15.7
Burnett	3	6	1.4	15.14	77.6	12.5
Calumet	6	66	1.2	16.11	79.6	13.6
Chippewa	5	54	1.4	13.98	78.1	12.3
Clark	5	90	1.3	14.46	79.7	10.7
Columbia	6	55	2.0	12.92	74.7	13.4
Crawford	4	18	2.4	12.31	77.3	12.0
Dane	5	78	2.0	13.56	74.8	16.0
Dodge	5	70	1.9	13.16	76.2	16.5
Door	4	25	1.7	15.20	79.4	12.9
Douglas	3	12	1.0	15.56	83.5	16.1
Dunn	6	50	1.6	13.41	78.5	14.3
Eauclaire	3	73	1.7	11.42	75.2	12.5
Fond du Lac	5	49	2.0	12.08	73.9	11.1
Forest	3	4	1.7	11.21	72.4	10.5
Grant	4	35	2.4	10.55	70.7	13.1
Green	4	12	1.8	11.80	73.5	18.1
Green Lake	4	16	2.1	13.38	78.4	13.8
Iowa	4	12	1.7	12.91	75.4	19.9
Iron	1	1	2.2	9.96	64.7	15.5
Jackson	4	79	1.8	13.21	77.9	8.3
Jefferson	6	61	1.7	13.83	77.5	18.4
Juneau	4	18	2.3	13.69	78.1	15.8
Kenosha	5	31	1.8	13.95	77.3	21.2
Kewaunee	6	125	2.2	14.26	77.5	12.0
Lacrosse	5	80	2.1	12.40	76.6	13.9
Lafayette	4	15	1.8	13.25	74.1	14.9
Langlade	2	16	1.8	12.21	76.1	17.6
Lincoln	5	18	1.0	16.32	82.7	9.6
Manitowoc	6	77	1.8	13.95	78.9	13.8
Marathon	4	62	1.4	13.49	76.3	13.5
Marinette	4	37	2.2	12.83	75.1	17.6
Marquette	4	34	1.2	14.56	80.4	14.1
Milwaukee	5	25	1.8	14.97	79.6	17.6
Monroe	5	46	1.6	13.37	76.1	11.4
Oconto	5	33	1.5	15.16	81.5	11.6
Oneida	3	8	1.4	15.23	77.3	10.6
Outagamie	5	108	2.1	13.19	77.0	19.7
Ozaukee	6	30	1.9	13.61	79.4	14.4
Pepin	5	14	2.2	16.33	81.0	16.1
Pierce	2	14	1.6	14.26	73.4	15.0
Polk	4	11	1.5	12.56	76.5	13.7
Portage	4	43	1.8	13.28	77.3	10.4
Price	3	13	1.3	13.67	74.8	8.6
Racine	5	27	2.1	14.85	79.7	18.3
Richland	4	26	1.8	12.04	71.8	14.1
Rock	5	72	1.6	14.23	78.1	14.1
St. Croix	5	54	1.4	13.69	76.9	12.1
Sauk	5	47	1.7	13.62	76.8	13.5
Sawyer	1	1	2.9	10.69	73.8	26.1
Shawano	5	37	1.5	14.40	79.5	13.5
Sheboygan	6	89	1.8	13.64	78.0	15.6
Taylor	5	27	1.3	15.57	78.5	10.8
Trempealeau	4	61	1.5	13.12	77.0	12.0
Vernon	2	37	2.3	12.55	74.5	13.1
Vilas	3	4	1.7	16.14	81.4	.....
Walworth	5	23	1.6	14.73	79.7	15.5
Washburn	3	7	1.3	12.80	77.4	13.3
Washington	6	53	1.8	15.14	80.4	15.9
Waukesha	5	76	1.8	14.68	80.0	19.1
Waupaca	5	83	2.0	13.15	76.7	12.1
Waushara	4	35	1.6	14.34	79.4	18.0
Winnebago	6	52	2.0	13.89	78.5	14.1
Wood	5	30	1.6	14.27	79.1	11.6
Unidentified	3	15	1.5	13.44	74.7	.....

It will be noticed that the counties of Calumet, Lincoln, Pepin, and Vilas furnished beets containing more than 16 per cent of sugar in the juice on the average; the counties of Burnett, Door, Douglas, Oconto, Oneida, Taylor, and Washington furnished beets containing more than 15 per cent of sugar in the juice, and beets

containing 14 to 15 per cent were supplied by the counties of Clark, Kewaunee, Marinette, Milwaukee, Pierce, Racine, Rock, Shawano, Walworth, Waukesha, and Wood.

By reference to a State map, it will be seen that all the counties mentioned in the preceding lie in the eastern, extreme northwestern, and central-northern parts of the State. On the other hand, the counties furnishing beets of less than 13 per cent sugar in the juice are located in the southwestern and central-western parts of the State—Columbia, Crawford, Eau Claire, Grant, Green, Iowa, La Crosse, Richland, and Vernon. These counties are located in the portion of the State occupied by the driftless area or the sandstone region immediately north of this driftless area. The counties which have furnished rich beets, on the other hand, are in the glacial drift area, either in the limestone region (eastern Wisconsin) or in the Keweenawan or copper-bearing group in the extreme northwestern counties of the State. A few counties outside of the driftless area gave low results, viz, Fond du Lac, Forest, Langlade, Marinette, Polk, Sawyer, and Washburn; but it seems certain that these counties would compare more favorably with the surrounding counties if more analyses were at hand. At any rate, with the small number of analyses available from these places, we are hardly in a position to generalize as to their adaptability to sugar-beet culture. The purity of the beets corresponds in general very closely to the sugar content, a high sugar content being accompanied by a high purity, and vice versa.

No beet-sugar factories were built in this State last year. The factory at Menomonee Falls, Wis., which, owing to financial difficulties, was abandoned in 1893, after a brief run, has been thoroughly examined by different parties with a view to resuming operations, but so far nothing definite has come of it. It is the plan of a Milwaukee company to start the factory again next year, but I am not certain that the matter has been definitely decided. The matter of establishing beet-sugar factories has been actively agitated during the past year at the following places in this State besides Menomonee Falls: Watertown and Green Bay. You will notice that all three of these places lie in the eastern part of the State, in counties where rich beets have been produced. The agricultural phase of the question would offer no difficulties in any of the places mentioned.

The legislature of 1898 considered a bill to pay a bounty on beet-sugar manufactured in this State, but after considerable discussion in both branches of the legislature the bill was killed in the senate.

The work done at our experiment station farm is shown in the following table of average results obtained with the different varieties of beet seed received for trial purposes either from the Department of Agriculture or from private seedsmen. The experimental field laid out for sugar beets was 40 feet wide and 550 feet long; soil, clay loam. It was divided into five plats, of which A and E received no fertilization; B, farmyard manure; C, a potash and phosphoric acid fertilizer; and D, a potash fertilizer. The object of applying the fertilizers last mentioned was to ascertain whether the purity of beets grown on our soil could be increased by special fertilization. The season was on the whole very favorable, especially in the first part. A drought during the months of August and September possibly reduced the yield some, but on the whole the season was considerably above the average. The stand of beets on the plats was perfect, and, so far as could be seen, there was not an open space or a weed in the whole field. The rows were run 15 inches apart, with beets 6 to 8 inches apart in the row. As you will notice, the average yield of beets per acre for the whole field was at the rate of 18.8 tons and that of sugar at the rate of 5,805 pounds, the average per cent of sugar in the beet being 15.41.

Beets from University farm, Madison, Wis., 1899.

Variety.	Plat A.		Plat E.		Plat B.		Plat C.	
	Yield of beets per acre.	Per cent of sugar in beets.	Yield of beets per acre.	Per cent of sugar in beets.	Yield of beets per acre.	Per cent of sugar in beets.	Yield of beets per acre.	Per cent of sugar in beets.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
Vilmorin	47,330	14.9	37,530	16.8	44,280	14.3	34,230	13.4
Zehringen	40,530	13.4	29,050	16.2	39,020	16.5	30,130	14.5
Dippe Kleinwanzlebener	40,230	15.4	29,800	17.0	39,070	16.3	28,670	15.8
Mangold	37,600	13.0	28,870	16.6	38,940	16.9	32,100	13.0
Kleinwanzlebener, Braune	36,490	13.3	28,780	17.4	41,930	14.0	30,890	14.6
Kleinwanzlebener, K. and S	38,550	13.5	29,610	15.3	48,630	13.7	32,910	15.6
Vilmorin, Nebr	38,750	14.9	30,590	16.3	41,680	15.7	32,590	15.7
Kleinwanzlebener, Nebr	38,470	16.2	29,980	16.6	44,620	14.6	35,940	15.1
Pitzschke	38,080	16.6	29,150	16.9	47,110	15.5	38,940	14.7
Rölker ZZ	39,600	15.7	28,080	17.4	48,950	13.8	39,310	14.6
Rölker EE	39,730	13.9	29,790	16.1	48,180	15.3	39,750	15.2
Rölker Dippe	41,690	14.6	30,210	18.1	49,030	15.2	39,430	14.9
Vilmorin	51,560	15.2	33,060	14.9	57,580	13.7	43,750	13.9
Average	40,662	14.68	30,269	16.58	45,309	14.95	35,280	14.63

Variety.	Plat D.		Whole area (one-half acre), all varieties.				
	Yield of beets per acre.	Per cent of sugar in beets.	Total yield of beets.	Yield of beets per acre.	Yield of sugar per plat.	Yield of sugar per acre.	Average per cent of sugar.
	Pounds.		*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Vilmorin	37,700	15.0	3,744.3	39,300	565.9	5,937	15.11
Zehringen	38,660	16.2	1,099.3	34,830	170.8	5,411	15.53
Dippe Kleinwanzlebener	32,970	16.1	1,064.7	33,740	172.7	5,470	16.21
Mangold	36,410	15.4	1,082.4	34,300	164.8	5,220	15.23
Kleinwanzlebener, Braune	34,100	16.6	1,073.6	34,020	165.6	5,247	15.43
Kleinwanzlebener, K. and S	35,180	15.4	1,147.1	36,340	169.0	5,355	14.73
Vilmorin, Nebr	38,660	16.7	1,136.6	36,000	181.3	5,744	15.95
Kleinwanzlebener, Nebr	34,360	18.0	1,140.6	36,130	183.1	5,801	16.05
Pitzschke	35,340	16.5	1,167.2	36,980	187.4	5,936	16.05
Rölker ZZ	38,870	16.5	1,195.6	37,870	187.6	5,943	15.69
Rölker EE	36,070	17.3	1,185.7	37,580	185.2	6,005	15.62
Rölker Dippe	40,310	17.0	1,236.1	39,150	199.4	6,319	16.14
Vilmorin	41,330	15.3	2,747.5	43,530	398.8	6,319	14.52
Averages and totals	36,920	16.29	19,020.7	37,660	2,931.6	5,805	15.41

Beet-Sugar Production in Germany from 1877 to 1899.[1]

In the following table can be found some very interesting data touching the beet-sugar production in Germany for the last twenty-two years. This table will give a notion of the area cultivated during the successive years, the amount of beets harvested, what the farmers received for the beets per ton, the value of the crop per acre, the total production of sugar for the various years, etc. It is interesting to note the gradual development of the industry until it has reached the present dimensions. In this connection it is also interesting to note that the total production of Germany is very nearly the amount that the United States imports every year for her own consumption. Germany is able to produce on an average 11.94 tons of beets per acre. It will be noticed that the farmers originally received $5 per ton for beets and the price gradually

[1] Compiled from articles appearing in the Sugar Beet, of Philadelphia.

dwindled down to $4. It is also interesting to note how the two items, "Beets required to produce a ton of raw sugar" and "The amount of sugar in the beets," sympathize with each other. Twenty-two years ago it required 10.82 tons of beets to produce a ton of sugar. This amount gradually decreased until last year the minimum of 7.1 tons of beets for a ton of sugar was reached. At the beginning of the same period the beets tested 9.24 per cent sugar on an average. Last year they averaged 13.15 per cent for the entire country for the season, reaching this maximum by a gradual rise throughout the intervening years.

This decrease in the amount of beets required for a ton of sugar and increase of the amount of sugar in the beets, gradual in both cases, and decidedly marked in the extremes, illustrate very clearly the advantage of experience both to manufacturing and sugar-beet growing, and is due to two causes: First, better methods of manufacture, in which the factory is able to extract from the beet more of its sugar content; and, second, careful breeding and selection of seed, by which beets of higher sugar content have been developed, and better methods of agriculture, by which the farmer is able to produce beets of better quality. This illustrates the point for which I have been contending throughout this report, namely, that when the factories and farmers through experience shall have been able to discover and adopt the best methods, the cost of sugar production will gradually become less as it has in every other country. It will be noticed in this connection as a natural consequence that the amount of sugar received from a ton of beets has increased about one-third, while the price of sugar beets has gradually gone down. At the same time it will be noticed that the selling price of raw and refined sugar has decreased in a more marked degree.

Statistics of beet-sugar industry in Germany, 1877–1899.

Year.	Area cultivated.	Beets harvested per acre.	Value of beets per acre.	Average price of beets per ton.	Beets worked.	Total production of raw sugar.	Beets required for 1 ton of raw sugar.
	Acres.	*Tons.*			*Tons.*	*Tons.*	*Tons.*
1877–78	258,809	11.088	$55.45	$5.00	4,090,968	378,009	10.82
1878–79	266,075	11.696	62.48	5.00	4,628,748	426,155	10.86
1879–80	279,230	10.199	55.57	4.85	4,805,262	409,415	11.74
1880–81	292,574	13.234	67.49	4.60	6,322,203	555,915	11.37
1881–82	299,624	11.453	61.28	5.40	6,271,948	599,722	10.46
1882–83	319,406	13.922	73.19	5.30	8,747,154	831,995	11.51
1883–84	347,924	12.100	63.83	5.30	8,918,120	940,109	9.49
1884–85	370,840	13.314	52.59	4.00	10,402,688	1,123,030	9.26
1885–86	343,145	12.221	46.44	3.80	7,070,316	808,105	8.75
1886–87	365,169	12.141	43.24	4.60	8,306,671	985,628	8.43
1887–88	651,815	10.084	49.68	4.70	6,963,961	910,698	7.65
1888–89	691,897	11.412	54.78	4.30	7,896,183	944,505	8.36
1889–90	752,259	13.314	61.25	4.60	9,822,635	1,213,689	8.09
1890–91	825,825	13.031	63.86	4.90	10,623,319	1,284,485	8.27
1891–92	861,583	11.412	54.21	4.80	9,488,002	1,144,368	8.29
1892–93	869,829	11.291	54.20	4.80	9,811,940	1,171,843	8.37
1893–94	954,995	11.125	55.65	5.00	10,644,352	1,316,665	8.10
1894–95	1,090,801	13.273	63.71	4.80	14,521,030	1,766,805	8.23
1895–96	930,749	12.546	51.44	4.10	11,672,816	1,537,522	7.63
1896–97	1,019,881	13.072	53.60	4.10	13,721,601	1,738,885	7.9
1897–98	1,079,810	8.619	50.48	4.00	13,697,892	1,755,229	7.8
1898–99	1,054,229	11.519	.....	.....	12,144,291	1,710,006	7.1

Statistics of beet-sugar industry in Germany, 1877–1899—Continued.

Year.	Sugar in the beet.	Mean prices per pound.		Raw sugar from 1 ton of beets.	Export bounties paid.	Export to United States.
		Raw sugar.	Refined sugar.			
	Per cent.	*Cents.*	*Cents.*	*Pounds.*		*Tons.*
1877–78	9.24	6.26	8.8	203.7	$4,249,531	.....
1878–79	9.21	6.1	8.37	203.04	6,035,673	.....
1879–80	8.52	7.44	9.28	187.83	5,745,652	.....
1880–81	8.79	6.69	8.74	191.8	13,458,421	.....
1881–82	9.56	6.69	8.85	210.75	10,332,190	.....
1882–83	9.51	6.46	8.15	209.66	17,706,645	.....
1883–84	10.54	5.66	7.66	232.36	22,919,935	.....
1884–85	10.79	3.93	5.61	237.88	30,571,744	.....
1885–86	11.43	5.08	6.53	251.99	21,436,084	.....
1886–87	11.87	4.11	7.72	261.69	25,899,398	.....
1887–88	13.08	5.13	6.48	288.36	25,125,184	11,426
1888–89	11.96	3.78	6.21	263.67	19,058,088	
1889–90	12.36	3.23	6.05	272.49	14,746,480	35,420
1890–91	12.09	3.45	5.88	266.53	18,648,728	140,293
1891–92	12.06	3.99	6.42	265.87	17,757,418	34,358
1892–93	11.94	3.02	5.88	263.23	8,199,338	113,319
1893–94	12.34	2.72	5.72	272.47	2,713,438	115,698
1894–95	12.15	1.84	4.48	267.86	3,576,044	134,128
1895–96	13.11	2.38	4.97	286.82	4,380,866	193,932
1896–97	12.66	2.14	5.04	279.1	6,083,756	500,139
1897–98	12.79	2.18	5.04	281.97	8,724,842	142,907
1898–99	13.15	2.25	5.13	310.42	.....	.....

THE CANE-SUGAR INDUSTRY IN THE HAWAIIAN ISLANDS.

In pursuance of instructions received from the Secretary of Agriculture, I visited the Hawaiian Islands this past winter (1899–1900) for the purpose of ascertaining such facts as might be interesting to the general public, and especially to those interested in sugar production. The acquisition by the United States of the Hawaiian Islands, Porto Rico, and the Philippines has caused, among those interested in the production of sugar in this country, considerable speculation and some concern as to future effects on this industry. In order to aid in arriving at intelligent conclusions regarding this subject, it was deemed advisable to gather information which would answer as nearly as possible the following questions:

First. At what rate of increase will the Hawaiian Islands furnish us sugar in the next few years?

Second. What is the probable maximum production of the islands when all their available resources are utilized?

Third. Will the future production of sugar be at a higher or lower average cost?

Fourth. What is the cost of production, especially the cost of such items as labor on the plantation and in the mill, fertilizing and irrigating the cane fields, and handling the product from the factory to the market?

Fifth. What is the status of the labor class considered from the social, industrial, and wage standpoints?

Seventh. What of the other agricultural products and industries of the islands?

Unfortunately I was prevented from making as full and complete an investigation as I had desired by the breaking out of the bubonic plague, which threw the city of Honolulu into a state of quarantine which was maintained against it for several months by the other islands, by other places on the same island, and by the ports of the United States. This curtailed the complete inspection that I had planned of all the plantations and the conditions pertaining thereto, and more work must be done before the investigation can be considered complete. After the quarantine regulations were fixed I had to direct my efforts to gathering the required data at Honolulu. Fortunately, Honolulu is the center for all business transacted in the islands; the plantations all have their headquarters there, and there it is possible to gather almost completely the facts pertaining to the sugar industry.

General Conditions Affecting the Sugar Industry of the Islands.

Under this head is presented such general information as may have a bearing on the sugar industry of the Hawaiian Islands. Their location is given, their topography described, and their climatic, soil, and trade conditions set forth.

LOCATION AND GENERAL DESCRIPTION OF THE ISLANDS.

The Hawaiian Islands belong to the Polynesian group. They are situated between 18° 54′ and 22° 15′ north latitude, and 154° 50′ and 160° 30′ west longitude. The general trend of the islands is from the southeast to the northwest.

Beginning at the southeast, we have Hawaii, the largest island of the group, from which the whole group now takes its name. They were formerly called the Sandwich Islands, a name given by Captain Cook, on their discovery, January 19, 1778, in honor of the Earl of Sandwich. The island of Hawaii has an area of 4,210 square miles. The whole group has an area of 6,700 square miles, Hawaii having nearly two-thirds of the whole.

The names of the other islands, as we go from the southeast to the northwest, following the natural trend, are as follows:

First, we have a group of three—the island of Maui, just to the west of which lie two smaller islands, Lanai and Kahoolawe. The next island in order is Molokai, the next is Oahu, and the farthermost of the eight larger ones are Kauai and Niihau, which latter is close to the south of Kauai. These are the eight larger islands which are capable of habitation and production.

It is generally accepted that these islands originated through volcanic eruption. Surrounding the base of each mountain or central elevation is a belt of table land which has been formed by the disintegration and washing down of the lava material. The work of the coral insect also has assisted a great deal in the formation of these level tracts, the coral reefs forming, as they do, a sort of outer wall in the sea and the base for the deposit of the disintegrated matter washed

down by the numerous streams on the inclosed shallow sea area. This coral formation has been the means of forming numerous harbors around the indentations and inlets.

In elevation these volcanic mountains vary, the highest peak being 13,805 feet. The shore line is broken by numerous indentations, giving opportunities for numerous harbors.

The rainfall varies in the cultivated regions from 3 feet to 15 feet per annum, the average of the islands being 42½ inches. It can be seen that this bountiful supply of rainfall gives opportunity for watering the soil either naturally or artificially.

There are some general conditions prevailing here which affect materially the productiveness of the islands, especially the principal crop grown, which is sugar.

TEMPERATURE.

These islands have a very equable climate. The variations between summer and winter are but slight; also the variations between night and day are not so extreme as are found in most other places. At Honolulu, along about 4 o'clock in the afternoon the temperature begins to go down, and while the evenings and nights are cooler than the day, they are always pleasant and comfortable. Neither does the climate present extremes from day to day. The history of one day is usually that of the day following and the day before it; the record for twelve years gives 89° as the highest and 54° as the lowest temperature. The average temperature for the year is 74.3°. At this port the average temperature from January 1st to July 1st is about 71.6°; from July 1st to January 1st, 75.2°. The temperature during the day in summer varies, as a rule, from 70° in the morning to 81° at 2 p. m.; in winter, from 68° in the morning to 75° at 2 p. m. It can be readily seen that this gives us an equable climate for the performance of any kind of business or manual labor, and the condition, so far as climate is concerned, is vastly superior to that of the West Indies or East Indies, or any of the tropical sugar producing countries. It is as conducive to comfort as the climate in any part of the temperate zone during the growing season. Consequently it will not do, in estimating the effect of heat on the power of an individual to perform manual labor, to conclude that workers can not perform as much manual labor in the Hawaiian climate as in the summer climate of the temperate zone. This argument, though applicable to other tropical cane-sugar-producing countries, does not apply to the Hawaiian Islands.

WINDS AND STORMS.

First may be mentioned the trade winds, which blow from the northeast to the southwest from the 1st of January to the 1st of October. On the windward side of the islands the tendency of these winds is to decrease the production of cane sugar, for two reasons—first, the agitation of the plant itself by these winds causes it to lean or fall, and causes more or less whipping of the leaves, which impedes the growth

and productiveness of the plant. Second, these winds carry to the plant the salt spray, which in itself is deleterious to vegetation.

On the leeward side of the island different conditions prevail. Production is more abundant where moisture is sufficient, and the effects of the salt spray are not felt. Generally speaking, the productiveness of sugar on the two sides of the island vary considerably. There are other conditions prevailing that tend to increase this difference in productiveness, the main one being the two systems of irrigation that prevail here.

A peculiarity of the islands is that the hazard of storms does not enter so much into their calculations. The condition in this respect partakes of the well-known mild and quiet character of the Pacific Ocean, so that in the production of crops and in the shipment of the product to market, not nearly so much danger is involved as there is in the case of the West Indies or the Philippines.

IRRIGATION.

There are three distinct sources of water supply available for growing cane, and the system of production in use depends upon the section in which the population is located. The first to be considered are those sections where crops receive their supply of moisture from the rain falling directly on the soil. This is the condition under which cane is grown largely on Hawaii, the principal island, which produces a larger amount of sugar than any other.

The systems of irrigation may be divided into two classes: One in which surface water is taken from the streams and delivered to the soil through canals, etc., the same as in California and the arid sections of the United States; another in which water is pumped from artesian wells to altitudes varying from 75 to 600 feet.

Irrigation by surface water belongs naturally to the windward side of the islands, and irrigation by subterranean water to the leeward side. The windward side of the islands being the one where the most rain falls, the streams mostly flow down that side, while on the leeward side, in order to obtain sufficient moisture, planters are compelled to sink artesian wells.

The lee side of the island is also favored in the matter of temperature, it being considerably warmer than the windward side, and it is well known that sugar cane is partial to heat. It should be remembered, however, that on the lee side of the island successful cane production can only be carried on where sufficient moisture can be secured by artesian wells and made available for irrigation, as most of the rainfall is on the windward side of the islands. As most of the natural drainage of the island is on the rainy side, the delta formations, the washings, and silt and soil deposits are here forming the "made lands" and the greater part of the more or less cultivable lands, so that the aggregate amount of sugar produced on the windward side is much greater as a rule.

Irrigation constitutes an important item of cost in growing cane on

these islands. It is one of the disadvantages here that so large a proportion of the cane must be grown by irrigation; outside of the island of Hawaii nearly all of the new projects that are being introduced or completed have an artesian water supply for irrigation. No doubt a great deal has been accomplished by the introduction of the artesian well as a source of water supply. A great deal has also been accomplished in perfecting pumps for throwing large quantities of water; also for elevating this water to higher altitudes than was formerly thought expedient. There is little doubt of the further fact that the sugar industry of the islands has reached the limit of profitable pumping of water to higher altitudes. There is no definite data yet as to the cost of pumping water to different altitudes; the most that is known at the present time is that water is pumped successfully onto plantations having lands whose altitudes vary between 50 and 200 feet, and if necessary water will be pumped up to the altitude of 600 feet. The further fact is known that these plantations, as a whole, do return a good profit on the cane grown, without being able to give the figures of the cost of pumping for the various altitudes; but the impression is gaining ground that the limit of altitude to which water can be pumped profitably for irrigation is not far from the highest extreme mentioned above, 600 feet. Very careful data is being sought after now on this subject, and it is believed by many who are well posted that this limit is going to shut out considerable of the lands that have been under cultivation or in contemplation for future growing of sugar cane, and that these lands will be used for other purposes not requiring so much water.

The following statement was prepared by a civil engineer who has been practically engaged in making surveys and investigations to secure data regarding the artesian water supply. The writer is M. M. O'Shaughnessy, president California Association of Civil Engineers, San Francisco, Cal.:

The sugar product of the Hawaiian Islands was last year 250,000 tons, which sold at an average price of $80 per ton, or a total value of $20,000,000. From a modest beginning some twenty or thirty years ago it has been gradually increased to the present amount by improved systems of cultivation, the main feature of which is systematic irrigation of the growing cane. Up to twelve years ago the only available sources of supply were the natural streams flowing in the mountains, which were diverted by means of long ditches over fairly smooth ground and in iron syphon pipes across the abrupt ravines, which break down the sides of the island mountain slopes.

Mr. Claus Spreckels, first owner of the Hawaiian Commercial and Sugar Company property on Maui, was the pioneer in this field, building the Haiku ditch, which leads the flowing streams from the northeast slopes of Maui westerly to the arid plains which connect the two mountain chains, West Maui and Haleakala. The capacity of this ditch was 60,000,000 gallons daily. The financial success of this scheme encouraged others to similar attempts until at the present time all the accessible flowing streams on the other islands are diverted to this use.

The presence of a great quantity of underground fresh water in Honolulu induced the Ewa Plantation owners on Oahu Island to explore this field, and after prospecting in a thorough manner they started, about twelve years ago, a 5,000-acre plantation, to irrigate which they rely on seven separate pumping plants of a daily capacity

of 50,000,000 gallons of fresh water, which is drawn entirely from wells. Roughly speaking, each 100 acres of land requires 1,000,000 gallons of water daily for irrigation purposes, but this proportion is varied by the soil and climatic conditions and the personal judgment of the plantation manager. The Ewa Plantation adjoins Pearl Harbor, and lies below an elevation of 200 feet, the average pumping lift being 80 feet. At the present time 28 tons of coal daily is being used for steam purposes, at an average cost of $10 per ton or $21 per acre per year. My estimate for cost of irrigating at a 500-foot average lift at present coal prices would be $60 per acre per year.

The success of Ewa with its low lift has induced many other plantations to embark on enterprises with higher lifts, but the financial success of high-lift propositions remains to be proven. The price of sugar and the cost of fuel will define a line which will be the limit, with local conditions in the field, at which high-lift pumping will pay.

No geological survey has yet been made of the islands which would enable me to accurately study the conditions governing the vast underground reservoirs which exist on all the islands. They are undoubtedly all of volcanic origin and of comparatively recent formation, from a geological standpoint. The general character of the rock is a highly porous lava, very absorbent in character, with occasional layers of tight metamorphosed strata.

The rainfall on the windward sides of the islands is very great, as the mountains are very rough and covered with vegetation, which acts as a condenser and precipitates the vapor-laden clouds which float southwesterly over them from the Pacific Ocean. As a general rule the windward or northeasterly slopes of the islands have a copious rainfall varying from 50 to 150 inches annually, and the southerly and southwesterly sides are extremely dry, averaging only 3 to 15 inches. The underground supply of fresh water is undoubtedly fed from the regions of heavy rainfall, and passes through the porous strata to the sea except where restrained along the shores by strata of clay and materials of recent deposit, which prevent its egress.

In Oahu the best water-bearing strata are tapped by wells at a depth of from 400 to 600 feet, and the water rises in Honolulu to a height of 40 feet above sea level, at Ewa about 20 feet above sea level, and east of Honolulu only 6 feet above sea level. The static level of the water varies with general conditions, such as rainfall and number of wells being drawn from. At the present time, after a season of prolonged drought, it rises to a height of 34 feet, or 6 feet below the normal level, at Honolulu.

About 300,000,000 gallons daily are now pumped for plantation purposes in Oahu, and many doubt if the underground supply will continue long to meet this excessive draught. Most of the water carries 40 grains of salt per gallon, which will grow good cane; but an excess of salt in the water proves fatal to the health of the cane.

From 5 to 10 millions of gallons are procured at each station by means of 5 to 10 wells 12 inches in diameter lined with $\frac{3}{16}$-inch iron casing. The wells are placed 50 feet apart, as a rule, and joined by 18 to 24-inch pipe placed near the static level of the water and connected with the water ends of the lifting pumps. The latter are placed in pits as near the water level as practicable, lined with concrete and connected by means of tunnels with the wells. In placing a pumping station it would seem desireable to have as large a portion as possible of solid formation between it and the sea so as to prevent any flow of sea water toward the station, and the consequent ruin of the water for irrigation purposes. Two types of pumping engines are largely used, the direct-acting, triple-expansion, high-duty engine, and the crank and fly-wheel engine. Each has special advocates, but enough data have not yet been procured of working expense to demonstrate which is the most economic.

A geological and stratigraphical survey of the islands is badly needed, as a large amount of money is thrown away each year on haphazard and unintelligent water exploration. Water development in the islands will always be in the hands of corporations or capital, as no encouragement is offered to the party with little money to indulge in expensive exploitation, the results of which might be of doubtful value.

SOILS AND CANE-PRODUCING AREAS.

While all of the soils found on the different plantations are due to the disintegration of the lava rocks, there is considerable difference in the physical and chemical properties of the different soils due to the different kinds of rocks and minerals thrown out of the different volcanoes, but a discussion of these soils would be too voluminous to attempt here except in a general way.

On account of the gradual rise of the land as we pass back from the sea, we find what are known as lowland and upland soils. It has been estimated that the average rise in altitude is about 300 feet per mile. On account of the volcanic origin of the islands they are rich in mineral plant food. On account of color, and physical, geological, and chemical composition, they have been divided into the following classes:

(1) Dark red soils formed by the simple decomposition of the normal lavas under climatic action, and more particularly where great heat and small rainfall have prevailed.

(2) Yellow and light red soils which differ not only in color but also in their composition from the dark red soils, these differences being due to special physical and chemical influences which mark their origin.

(3) Sedimentary soils derived from the decomposition of lavas at high altitudes, the decomposed matter being removed by rainfall and deposited over lower levels.

Thrum's Hawaiian Annual, the official authority in the islands on all statistical questions, gives the following results of official investigation, showing the fertility and value of the different soils as evidenced by the amount of sugar an acre of each will produce: Dark red soils, 10,411 pounds of sugar per acre; sedimentary soils, 10,301 pounds; and yellow soils, 6,291 pounds.

On an average two years are required to make a crop of sugar in Hawaii, while only one year is required in Louisiana, so that the Hawaiian yield per acre requires to be cut in two in order to compare more accurately with the annual production of Louisiana.

ACREAGE AND YIELD OF SUGAR IN THE ISLANDS.

The area of arable lands growing sugar in Hawaii may be deduced from the figures in the following table from Thrum's Annual, which also shows the annual production of sugar:

Acreage and yield of sugar, 1895–1897.

Year.	Cane manufactured, acres.	Sugar produced, tons of 2,000 pounds.	Yield of sugar per acre, pounds.
1895	47,399½	153,419½	6,470
1896	55,792	227,093	8,148
1897	53,825½	251,126	9,331

The average number of acres of cane manufactured for the three years was 52,318. As the crop requires most of two years to mature, and as two crops are always growing at the same time, it is seen that the acreage under cane is not less than 105,000 acres. Since some small areas of extreme uplands are two and one-half years in reaching maturity, the above area must be considerably added to.

Considering the further fact that some portion of the total area is always lying out for rest, we are justified in concluding that the land in use for cane growing is 125,000 acres.

The sugar industry is confined to belts of table-lands around the islands, and valleys between the mountains. The altitude at which cane has been successfully grown varies between 20 and 3,000 feet above the level of the sea. Of course, in the higher altitudes the water supply is from rainfall and surface irrigation.

FERTILIZERS.

There are some soil elements that are properly demanded to make a success of growing sugar cane, such as lime, phosphoric acid, potash, and nitrogen. Some of these soils seem to abound in some things and to be lacking in others, such deficiencies being met with the application of fertilizers. All of these lands have to be reenforced with a liberal application of different kinds of fertilizers, depending upon the absence or presence of these elements in available form. It can be stated as a general average that these fertilizers cost about $45 per ton, spread on the soil, and that it requires about a half a ton per acre per crop. The supply of fertilizers is entirely imported, some of it as crude material to be mixed and delivered to the planters by companies organized for the purpose, and some of it all ready for use by companies in the States.

The crude materials entering into these fertilizers are acid phosphate of lime, from the East, usually from Florida and South Carolina; potash salts, imported from Germany; sal ammoniac, imported from Europe; nitrate of soda, imported from Peru; bone, blood, and fish guano, imported from both the East and the Pacific coast. Fish guano is a refuse of the fish-oil factories and salmon-canning factories, which are distributed along the coast from San Francisco north. Large quantities of this are being shipped to the islands.

ESTIMATED MAXIMUM PRODUCTION.

The production of sugar in the islands for some time has been below 250,000 tons per annum. For last year (1899) it is given as 282,000 tons. The estimated yields for the next three years are: For 1900, 310,000 tons; for 1901, 333,000 tons; for 1902, 360,000 tons.

The past year has been marked by an increase in lands used for growing cane, owing to the stimulus of annexation. Several new companies have been organized. Most of the companies have been able to add more or less to their available lands, all of which tends to increase the amount of production in the islands. The increase is also due, in part, to the introduction of a higher grade of farming machinery, bringing

the lands under better cultivation, more intensive farming, and better methods of manufacturing. The increase in the production of sugar is steadily growing. A careful estimate made here puts the limit of future production at about 500,000 tons. This figure seems to be accepted unanimously by those best informed. A close look at the relief map of these islands will show that there is a limit to the amount of their production. The area that can be devoted to sugar is quite small, as compared with the whole area. The average cost of production will then be considerably higher than at present, on account of the extra expense for pumping water to higher altitudes.

CANE CULTURE.

Cultivation is carried on through animal and steam power. The systems of cultivation and manufacture in use here are probably the best that can be devised. Money has not been spared to bring this industry to a high state of development. The animal in use here is the best quality of mule, and they use the most modern kinds of implements. The steam plow is being introduced; it is capable of doing a large amount of work and doing it well. It goes down to a depth of 14 to 18 inches, and is capable of stirring from 8 to 12 acres a day. It takes about eighteen months to produce the first crop of cane. As a rule, they can produce one crop of rattoons—sometimes two. A man well versed in such matters tells me that they rattoon where they can produce 30 tons of cane to the acre, but there is considerable acreage on which cane is produced without rattooning at all.

Sugar cane on the Hawaiian Islands is cultivated as follows: In the case of irrigated cane, land is prepared either by steam or mule plowing, harrowed down smooth, and then laid out in lands for irrigation. Water is laid onto the fields through the main ditch and distributed by subditches. The furrows for the planting of the cane are made about 5 feet apart and 15 inches deep. The cane is planted in the furrows. The irrigation water is then let into the first furrow until the same is full, when the supply end of the ditch is closed and the irrigator steps along to the next furrow, and so on through the whole land. No cultivators or plows enter into the growing of sugar cane after it is planted; all work is done by hoes. The fertilizer is sometimes put in the furrow when the cane is planted, and at other times, after the cane is up about 18 inches, it is dropped along in the furrow as evenly as possible at the rate of 1,000 pounds per acre. When the cane is up large enough the field hands usually go in and pull out small weeds, keeping the field clean until the cane has grown large enough to shade the entire ground, when the weeding and hoeing are no longer necessary. When the cane has grown so high that the lower leaves die from shade the leaves are stripped off. This is continued from time to time until the cane is properly matured. The leaves of the cane when stripped are laid between the furrows in which the cane is planted and remain there until after the crops are cut off.

The time of planting is from May to September, and cutting begins in December the year following. In other words, the cane tassels during September and October in the year after planting, and it is considered mature and ready to cut in December. The time occupied in harvesting nearly completes the two years. The cutting is done by hand; the cane is thrown in rows; from there it is taken up by the men, laid on the cars or carts, or in the flumes, as the case may be, and transported to the mill.

The field is now ready for rattooning. The trash is allowed to lie upon the ground for a couple of weeks when it is set on fire and the field is burned over. In such parts as are not well burned the trash is piled. In some two or three weeks the rattoons will spring up, and they are cultivated in precisely the same manner as the planted cane. But if the plantation is not rattooned, the ground is ready for another crop to be planted. The foregoing applies to irrigated plantations.

The method followed on plantations where the moisture is derived from natural rainfall is as follows: The land is prepared in the same manner as for an irrigated plantation, but the furrows are comparatively shallow, as in farming for corn or potatoes. The cane is planted in the furrows and is slightly covered. The rows are about 5 feet apart, but admit of entering with cultivators and horses. The cultivator begins working through the cane in the same manner as in cultivating corn. This is followed up with the hoe, which is used in cleaning around the cane stalks, so that the field is kept entirely clean from grass and weeds. This continual cultivation fills the furrow in which the cane is planted, and by hoeing it is slightly hilled up from each side, leaving a slight depression between the rows. It is necessary to keep constantly cultivating and hoeing on account of the vigorous growth of weeds and grass occasioned by the constant rainfall in the tropical climate until such time as the leaves of the cane plants shade the ground. The future treatment of the crop is the same as in the case of irrigated fields. It might be mentioned in this connection that it is the custom of the planters to fertilize their rattoon crop the same as the other; that is to say, the average of fertilizer applied would be a half ton per acre for every crop raised.

FACTORY METHODS.

It is not necessary to go into a discussion of the process of milling this cane, except to say that it is very similar to the best methods used in every other section where sugar cane is grown. In the methods and implements of cultivation and in the machinery used in the manufacture of sugar from this cane the very best are used here. I suppose that in no other place in the world has this industry reached the excellence of methods and machinery found here. Nearly all the mills have the nine-roller system; that is to say, the cane is crushed with three different sets of rollers of three each.

As already stated, in most cases the factory and the land upon which

the cane is grown both belong to the same company. The exceptions to this rule are in cases where plantations are rented to small leaseholders, who take from 20 to 50 acres, grow the cane, and have it milled, sharing in the amount of sugar produced.

YIELD PER ACRE OF CANE AND SUGAR.

It is stated of cane grown on these islands that it takes, as a rule, seven and one-half tons of cane to produce one ton of sugar. Of course there is some cane grown here which does a little better than that, and other cane that hardly comes up to that figure, but this seems to be accepted as the general average.

One curious fact in connection with the cane grown here as compared with that grown in Porto Rico and Cuba is the amount of cane they produce per acre for a single crop, followed with the uncertainty of rattooning for even once. It may be set down as a general rule that 30 tons of cane to the acre is considered a small crop. So much is this true that rattooning is not resorted to unless 30 tons to the acre can be produced by it. The better crops yield 50 to 60 tons of cane to the acre, and the best as high as 70 to 75 tons. The sugar growers generally estimate the average sugar produced per acre as 5 tons; but there are cases where a plantation will average in its production 10 tons of sugar per acre, and even this figure has been exceeded. In 1889 one plantation, with considerably over 2,000 acres in cane, two-thirds of which was first crop and the other third rattoon, averaged $10\frac{1}{10}$ tons of sugar per acre. One case is reliably reported in which a tract of ground of over 100 acres produced an average of 14 tons of sugar per acre. Of course this is an extreme case here, and I think in excess of anything known anywhere else. It should not be imagined that these conditions prevail extensively. On the contrary, there are a few plantations here which, owing to deficient supply of moisture or unfit soil, have not been able to produce sugar on a paying basis even under the present prices, and with a tendency of sugar to go down in prices rather than up the probabilities are that some of the area in sugar at the present time will be devoted to other crops, thus offsetting to that extent the increase on account of better methods of cultivation and newer lands being brought into use.

MANNER AND COST OF TRANSPORTATION.

In most cases here the plantation and factory are combined under one management, and the factory is connected with the plantation by means of movable car tracks, on which cars are run to carry the cane to the factory and which constitute a medium of communication between the factories and the cultivated lands for all purposes. In most instances the steam engines are used in moving these cars back and forth. Thus the plantation itself is connected to the railroad, by which they deliver their product to the railroad shipping station or seaport. In other instances mule power is used.

There is a peculiar innovation practiced in several districts which probably does not exist to any extent in any other sugar district in the world. This is the process of transporting the cane from the fields to the mills by water flumes. The main flumes are led from the fields to the mill precisely as the permanent railroad. They are constructed of wood. From these V-shaped flumes, extending from stations along the main flume into the field, are smaller flumes the same as the portable railway track, which are moved from place to place over the field. The water is turned into these V-shaped flumes and the cane is then thrown in, carried to the main flume, and thence to the mill; here the water drops through the grating and the cane goes onto a carrier, which conducts it to a crusher.

It is estimated that it will cost from $10 to $12 a ton to place sugar from these local ports into the port of San Francisco. This cost is made up of local freightage, dockage, export freightage, insurance, and other expenses that naturally enter into the shipment, the cost being higher in case of the sugar that has to be brought to Honolulu for shipment abroad than with that which goes from the port nearest where it is grown direct to market. For some time there has been a considerable amount of sugar that goes from the islands around Cape Horn to New York. This is estimated at about 50,000 tons. The rest of it goes to the Pacific coast through the port of San Francisco, and there it is refined and prepared for general consumption, or it is transported overland to its Eastern market. Railroad transportation on this sugar from San Francisco to its Eastern market is about $8 per ton.

The prospects are bright for considerable increase in facilities for water transportation between the ports of Honolulu and New York. A company in New York is putting on four large steamers, which will make Honolulu, San Francisco, and Seattle, and on their return Seattle, Honolulu, and New York. It will cost about $8 per ton to lay this sugar down in New York by this route from Honolulu. The time in shipment will be about sixty-five days. This is very apt to settle two questions: First, that considerable of the freight of the islands will be brought to the port of Honolulu by Atlantic coast steamers, and, second, that the bulk of Hawaiian exports will go around Cape Horn to New York for less than the cost of railroad shipment from San Francisco to New York, thus saving cost of shipment to San Francisco.

HARBORS.

The islands are especially provided with harbors, protected in the natural formation of the islands. While these harbors are not numerous, they are sufficient to do all the shipping that the most sanguine expectation has in view for the future commerce of the islands. There are three harbors that will probably take care of all the foreign shipping necessary in these islands. The first one is at Honolulu, which has been the seat of Government of the islands for a century or more,

and the center of commerce of these islands with the outside world. On Hawaii, which is the principal island in size and production, is the port of Hilo. This harbor has had the natural conditions, if it had been provided with whaves, etc., to take care of the shipping necessary to handle the imports and exports of the islands, but it has never been able to establish itself in this respect, as Honolulu, being the seat of Government and therefore the seat of influence, has been able to control the bulk of the foreign shipping. Hilo, during the past year, has been able to forge ahead considerably in the volume of her foreign shipping, and it is thought in the future that she will gradually establish herself in this respect, and finally control most of the foreign shipping that has to do with this island. The bubonic plague has aided materially in this respect, since the Government has directed that Government transports going between San Francisco and the Philippines shall make their stop at Hilo instead of Honolulu; also, sugar shipped from this port does not run the risk of quarantine, and its regulations incident to the prevalence of the plague, as would sugars shipped from Honolulu. These favorable circumstances have stimulated shipments from Hilo, the shipping facilities have necessarily had to be enlarged, and the value of this port has been emphasized.

The United States Government some years ago secured by treaty with the Hawaiian Islands Pearl Harbor for the purpose of a coaling station for her Navy and shipping. This harbor, in all its natural arrangements and advantages, is one of the finest on the Pacific Ocean. It is almost completely inlocked, has many strategic advantages, either for commercial or naval uses. With the expenditure of a few hundred thousand dollars to give it a deep channel to the ocean, it will have capacity for taking care of the entire United States Navy with room to spare. If the Isthmian Canal shall be completed and the tide of commerce turns to the Hawaiian route, this harbor will probably be the great haven for shipping of all kinds, provided it shall be properly equipped for this purpose. I quote from the report of the Hawaiian Annexation Committee, covering the subject of harbors as follows:

> Although the harbor and limited roadstead of Honolulu have for a hundred years or so furnished the wharf privileges and anchorage ground for numerous vessels of all classes which have visited the islands, there is already such a pressing demand for an early increase in harbor room, wharf area, and anchorage in the Honolulu Harbor, as to make necessary the immediate consideration of measures for additional harbors and wharves.
>
> Within 6 or 7 miles of Honolulu lies Pearl Harbor, a most valuable feature of our Hawaiian acquisition. It is the only place capable of use as a naval station in the North Pacific Ocean, except immediately upon the American coast. It consists of an inland lake containing 8 square miles of water, about half of which is from 5 to 10 fathoms deep, admitting the largest ships. The remaining portion has a depth of from 2 to 4 fathoms. It is accessible from the sea by a passage a third of a mile in width, which after a small amount of dredging will become a safe and excellent entrance for vessels.

This harbor is many times larger than that of Honolulu, and it offers to the United States facilities for the increase of the Pacific and Oriental commerce, the value of which can not be estimated. If the United States shall develop this desirable place, as it may easily do, it will afford the American Navy the most advantageous spot for a coaling station and naval depot to be obtained anywhere.

No other inclosed harbor exists in any group for thousands of miles north or south. One writer says:

"The naval power owning Pearl Harbor will therefore hold in complete monopoly the mastery of the Pacific Ocean north of the equator. Pearl Harbor is the chief jewel of the Hawaiian group."

Owned now by the United States, it offers us the key to the commerce of China, Japan, and Australia.

DESTRUCTION OF FORESTS.

One of the painful sights to be observed in making an inspection of the islands is the extravagant way in which they have been, and are still being, denuded of their forests. This has resulted from two causes, both of which are chargeable to the introduction of civilization and the development of enterprises which follow in the wake of civilization. As a sort of companion to the sugar industry, and to some extent its rival, is the cattle industry. Vast tracts of land have passed under the control of cattle men. These lands are usually lying upon the sides of mountains, the forests, and any other land that may be classed as grazing land. Large herds of cattle have been placed on these lands for the purpose of grazing. From this source, most of the meat of the islands is obtained. These herds have usually been worked up from the old native stock by crossing with better stock. Cattle were originally introduced after the discovery of the islands, and along with other kinds of domestic animals were allowed to run wild, so that they developed all the characteristics of wild cattle. The forests are covered by a dense, tangled growth of vines, giving the character of dense thickets or jungles. Under such conditions bark on the trees grows very tender in texture. Droves of these wild cattle going into the forests hook and tear down the vines, exposing the trees with their tender bark to the direct action of the sun, which kills them. On vast areas of forests these dead trees stand with their white trunks in the air like monuments of past greatness. Such sights can be seen in different sections of the islands.

In other instances, where the cattle have not accomplished the destruction of the forest, the sugar planter is accomplishing what the cattle left undone. Whenever they can find ground that experience has taught them would, if cleared, be good sugar-cane land, the forest trees are torn out and the land made a part of the plantation. I have in mind one plantation, the whole area of which is being cleared out of the forest. In this forest are great quantities of timber suitable for fuel, also other timber of superior quality, fit for the best kind of finishing lumber, counted by cabinetmakers equal to mahogany. This company is expending $1,000,000 simply to clear off the timber and get

the ground ready for the plow. This timber is cut and piled and burned. It simply goes up in smoke, and the forest is gone forever. One plantation company is trying an experiment of bringing down to the islands a cargo of petroleum from California to see if it will facilitate the burning of these piles of timber.

COOPERATIVE FARMING.

Experiments have been carried on by some of the companies in letting out small tracts of ground to individuals who plant, cultivate, and deliver the cane to the factory, and receive in payment therefor a certain stipulated amount of sugar, for which they are credited with the cash value according to the market price on the day of the delivery of cane. The amount allowed the leaseholder varies considerably, ranging between one-half and two-thirds of the sugar produced. I believe that this system has worked satisfactorily whenever it has been tried, and some even go so far as to claim that in it lies the future solution of the labor problem. I am confident that it will be very fortunate if this idea shall be accepted, as it will tend to enhance the importance of the individual and give the citizenship of the islands a higher rank in the future than will be the case under a system involving only hired labor. If the system should go further and extend to the individual cane grower the opportunity to own or control the land he works as an individual proprietor, then the ideal method will have been found. Under such conditions the Hawaiian Islands would be moving forward squarely on the highway of civilization, with a destiny to work out in common with the rest of the country of which she has become an integral part.

NEED OF AN EXPERIMENT STATION.

In regard to the other agricultural industries of the islands the following may be said: Something has been accomplished in coffee growing, but I believe the industry as a whole is receding rather than gaining. Rice culture has gained a little foothold, but it is really an outgrowth of the sugar industry, as most of the laborers employed on these plantations and in the mills are Japanese and Chinamen, and their principal food is rice. The great success of the sugar industry and its profits have carried almost everything along in the direction of this industry. Nothing seems to gain much headway that is not in some way connected with the sugar industry, but the time is coming when the sugar industry will have reached the limit of its expansion. There are a great many things that should have a place in the agriculture of those islands. It ought to be the ambition of every country to be as nearly self-sustaining as possible. There is a field for other things without interfering with the legitimate claims of the sugar industry. It is surprising to learn the high cost of ordinary things needed in the daily life of the people on the Hawaiian Islands, most of

which could be produced there as readily as anywhere, and some of which could be produced there a great deal more readily then anywhere else.

In order to test the agricultural capabilities of the islands, an experiment station working along lines similar to those in the States should be established in the Hawaiian Islands. Quite a number of bright, intelligent, and, I might say, philanthropic men have given their money and time to investigating the agricultural resources of the islands, working simply as individuals. The results of such work should all be gathered and published in such form as to be most useful in developing the agricultural resources of the islands. The experiment station should investigate these resources, lead the agricultural thought, and create a new agricultural intelligence. This will inspire those already at work to stronger and more diligent efforts, and will induce others to come and participate in giving these islands a successful list of agricultural products.

The Islands and Plantations Described Separately.

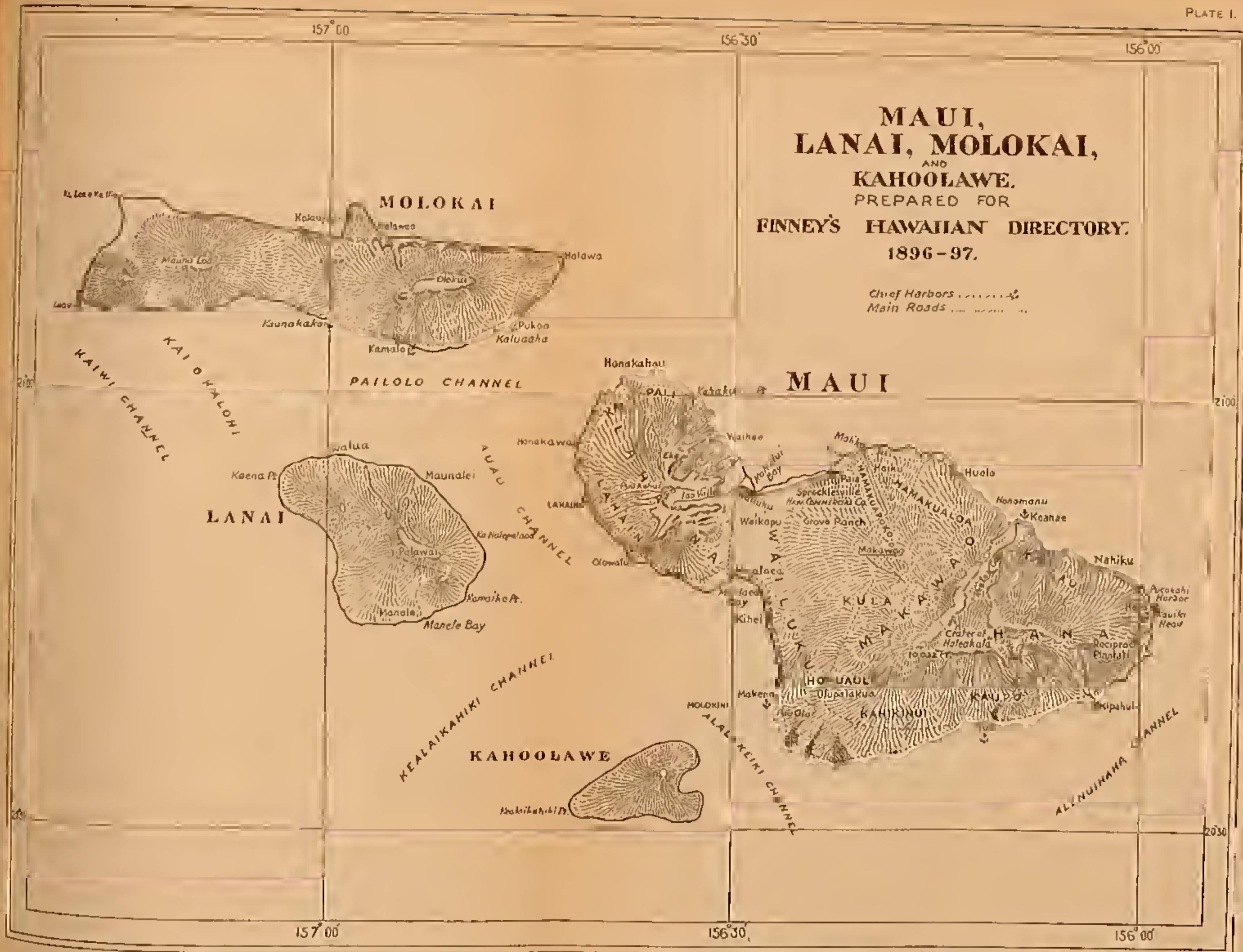
Under this head the four principal islands are described separately, and nearly all the plantations on each are given and briefly described. The maps have been reproduced from Finney's Hawaiian Directory, for which they were prepared by Mr. S. M. Kanakanui, a native Hawaiian artist.

THE ISLAND OF MAUI.

This island extends in its greater length nearly east and west, the western extremity being a little north of west (Plate I). Its general form is something like the figure "8," lying with the lesser loop extending to the west. We might imagine the center of each one of these loops to be the position of an extinct crater, and the loops themselves to have been formed by the overflow of lava from these craters, which, by disintegration and washing, has formed the table-lands on which are situated the cultivated lands, including the plantations.

The highest elevation on the eastern portion is the crater of Haleakala, 10,032 feet, and the highest elevation of the western portion is the crater of Eke. Between these two mountains the disintegration of the lava and the washings of the rainfall have formed a valley of 10 miles from the north to the south and about 12 miles from the east to the west. The annual rainfall on the island is 50 to 60 inches. The principal ports of the island are Kahului and Hana. Beginning at the western end of the island and following the southern border, which is the lee side of the island, passing thence around the east end of the island to the northern side back to the place of beginning, the plantations will be considered in their order.

Pioneer Mill Company.—This plantation is 90 miles from Honolulu. The total available acreage of the plantation is 12,000. The


MAUI,
LANAI, MOLOKAI,
AND
KAHOOLAWE.
PREPARED FOR
FINNEY'S HAWAIIAN DIRECTORY.
1896-97.
Chief Harbors
Main Roads
157° 00'
156° 30'
156° 00'
MOLOKAI
Halawa
Kaunakakai
Pukoo
Kaluaaha
Kamalo
PAILOLO CHANNEL
KAIWI CHANNEL
KAI O KALOHI
MAUI
Honokahau
Waihee
Kahului Bay
Huelo
Honomanu
Keanae
Spreckelsville
Grove Ranch
Waikapu
Makawao
Nahiku
KULA
Crater of Haleakala
HONUAULA
Makena
Kipahulu
KAUPO
KAHIKINUI
Olowalu
Kihei
LANAI
Kaena Pt.
Maunalei
Palawai
Manele Bay
Kamaiki Pt.
AUAU CHANNEL
KEALAIKAHIKI CHANNEL
KAHOOLAWE
ALALAKEIKI CHANNEL
ALENUIHAHA CHANNEL
MOLOKINI
21° 00'
20° 30'

number of acres cut last year was 1,764½, and the total number of acres growing cane is 5,000. The number of acres available for future cultivation is 7,000. In 1899 the amount of sugar produced was 10,589 tons, the yield of sugar per acre being 6 tons. It took 6¾ tons of cane to produce 1 ton of sugar. The capital stock of the company is $2,000,000, all paid up. The number of shares into which the stock is divided is 20,000, and the par value of stock per share is $100.

On this plantation cane is grown by irrigation and rainfall, and the larger portion of the water is pumped from artesian wells, six pumping stations being employed and five more planned. The daily pumping capacity at present is 25,000,000 gallons, and will be 45,000,000 gallons when complete. Water is pumped to an elevation of 420 feet. This is a nine-roller mill. The percentage of sugar extracted from the cane is 94 per cent. A small amount of water is brought from the flumes, which also carry cane. There are about 3 miles of these flumes. This is a model plantation, being the best producing plantation on the island of Maui. It is entirely protected from the winds—very warm and still. The elevation of the plantation varies between 20 and 900 feet, averaging 200 feet. Steam plows are used. There is a steam railway in connection with movable tracks, and a trolley line. Sugar is shipped to Honolulu by steamer, and from there exported.

Olowalu Sugar Company.—Last year (1899) 1,502 tons of sugar were produced. The capital stock is $150,000, all paid up. The stock consists of 1,500 shares of $100 each. In its physical conditions, Olowalu has two kinds of soil. Meteorological conditions are exactly like those of Pioneer Mill Company's plantation. Sugar is transported to the port of Honolulu for exportation.

Kihei Plantation Company.—This is a new plantation, which is being put into a state of cultivation. It lies at the mouth of Maillae Bay, at the base of Haleakala, and has an elevation varying from 100 to 800 feet. The cane is grown entirely by irrigation. Steam plows are used. A portable railway will be used to carry the cane to the mill. This plantation will grind its cane at the Hawaiian Commercial and Sugar Company's mill for the first ten years of its production. Prospects are that it will be a very productive plantation.

Kipahulu Sugar Company.—This company owns in fee simple 1,500 acres of land, and has 1,500 acres more leased, making a total acreage of 3,000. The number of acres cut last year was 390, the number of acres under cultivation 900, and the additional number of acres available for future cultivation 100. The number of tons of cane required to produce a ton of sugar is 7. The total amount of sugar produced per acre is 5 tons. Last year 1,931 tons of sugar were produced. The capital stock of the company is $160,000, all paid up, and divided into shares of $100 each.

This plantation lies on the windward side of the island and in the eastern division. It has a five-roller mill. Its daily capacity is 15 tons

of sugar. The sugar extracted from the cane equals 89 per cent of the total sugar content. The cane is grown entirely by rainfall. Plowing is done by mule power. The elevation varies from 50 to 2,000 feet, the average being 700 feet. This plantation is free from prevailing winds, and consequently lies very warm and free from spray. The sugar is shipped to Honolulu by steamer, from which port it is exported. The plantation has 4 miles of flumes, through which water and cane are conveyed.

HAMOA PLANTATION COMPANY.—Last year 2,026 tons of sugar were produced. The capital stock of the company is $175,000, all paid up. It is divided into shares of $100 each.

This plantation lies upon the leeward side of the island, although it is on the eastern extremity, and is swept occasionally by heavy winds. The elevation is from 50 to 2,000 feet, and the cane on the upper lands is grown entirely by rainfall. Plowing is done by mule power. On the lower lands irrigation is employed. The sugar is shipped to Honolulu and exported from there.

HANA PLANTATION.—The amount of sugar produced in 1899 was 3,175 tons. The capital stock of the company is $1,000,000, divided into 50,000 shares of $20 each.

The Hana plantation brings us around to the windward side of the island. Cane is grown by rainfall entirely. Plowing is done by mule power, and cane is transported to mill by steam railway. The elevation is between 50 and 2,000 feet. Sugar is shipped direct from Hana to San Francisco, and some is sent to Honolulu by steamer for exportation.

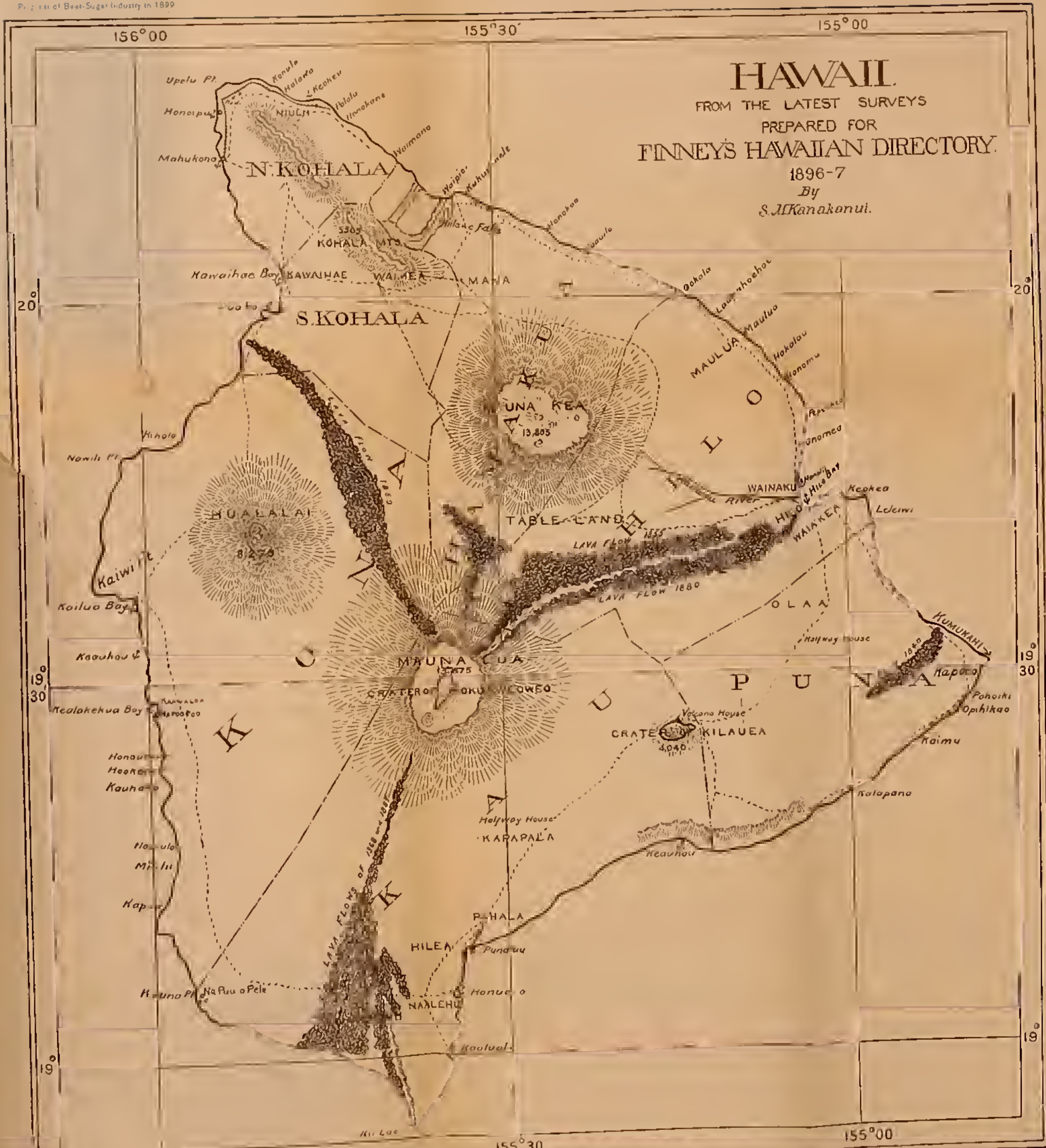
MAUI SUGAR COMPANY.—This plantation is a new one, organized and capitalized by Chinese solely. The plantation has an elevation varying between 100 and 1,200 feet. It will be irrigated.

HAIKU SUGAR COMPANY.—Last year 4,865 tons of sugar were produced. The capital stock is $500,000, all paid up. It is divided into 5,000 shares of $100 each.

The plantation is subject more or less to the effects of the winds. It has an elevation varying between 100 and 1,200 feet. The cane is grown by irrigation. Plowing is done with steam plows. There is a steam railway for transporting the cane from the fields to the mill. The sugar is shipped direct from Kahului to San Francisco; also some of it is sent by steamer to Honolulu and from there exported. This is a successful plantation.

PAIA PLANTATION COMPANY.—Last year 6,268 tons of sugar were produced. The capital stock is $750,000, all paid up. It is divided into 7,500 shares of $100 each.

This plantation is on the windward side of the island, and its general conditions and methods of cultivation are very similar to those of the Haiku Sugar Company. The elevation is about the same. Cane is grown by irrigation. Steam plows are used, and there is a steam rail-


HAWAII
FROM THE LATEST SURVEYS
PREPARED FOR
FINNEY'S HAWAIIAN DIRECTORY.
1896-7
By
S. M. Kanakanui.
156°00
155°30'
155°00
20°
19° 30
19°
N. KOHALA
S. KOHALA
KOHALA MTS.
5505
NIULII
Upolu Pt.
Honoipu
Mahukona
Waimanu
Waipio
Hiilawe Falls
Honokaa
Kawaihae Bay
KAWAIHAE
WAIMEA
MANA
MAULUA
MAUNA KEA
13,805
HUALALAI
8,275
TABLE LAND
WAINAKU
HILO
Hilo Bay
WAIAKEA
Keokea
Leleiwi
LAVA FLOW 1855
LAVA FLOW 1880
LAVA FLOW 1859
OLAA
Halfway House
KUMUKAHI
Kapoho
Pohoiki
Opihikao
Kaimu
Kalapana
MAUNA LOA
13,675
CRATER OF MOKUAWEOWEO
PUNA
Volcano House
CRATER OF KILAUEA
4,040
Kailua Bay
Keauhou
Kealakekua Bay
Kiholo
Kaiwi Pt.
K O N A
K A U
Halfway House
KAPAPALA
Keauhou
LAVA FLOWS of 1868 and 1887
PAHALA
HILEA
Punaluu
Honuapo
NAALEHU
Na Puu o Pele
Kaulana
Ka Lae
156°00
155°30
155°00

way. Sugar is exported directly from the port of Kakului by sailing vessels and steamers to San Francisco.

HAWAIIAN COMMERCIAL AND SUGAR COMPANY.—This company has a plantation of 45,000 acres, of which it owns in fee simple 35,000 acres and leases 10,000. There are 18,000 acres of cultivable land. Last year 2,538 acres of cane were cut. There are 13,000 acres of land available for future cultivation. Last year 16,500 tons of sugar were produced. The amount of sugar produced per acre was 6½ tons. The capital stock of the company is $10,000,000; amount paid up, $2,312,750. The number of shares is 100,000, the par value of each being $100.

This plantation is situated in the valley between the two mountains and reaches from sea to sea. It is the largest plantation on this island, and one of the largest in the industry on the Hawaiian Islands. It is more or less affected by the trade winds, which draw down through the valley. The elevation varies between 100 and 500 feet, the average being 200 feet. Crops are grown by irrigation from artesian wells and by rainfall. Steam plows and steam railway are both used on the plantation. The sugar is transported to Honolulu by steamer and exported from that port, or it is shipped direct to San Francisco from Kahului. It has a 9-roller mill and is a very successful plantation.

WAILUKU SUGAR COMPANY.—Last year (1899) 7,412 tons of sugar were produced. The capital stock is $700,000, all paid up. The number of shares of stock is 7,000, each having a par value of $100.

This plantation lies at the base of Eke, extending from Waihee to Waikapu. It is a favored plantation, being almost entirely free from heavy winds, and producing fine, full crops. The cane is grown by irrigation. It is equipped for steam plowing and has a steam railway. The sugar is transported to the port of Honolulu and there exported. This is a successful plantation.

ISLAND OF HAWAII.

This is the largest island of the group, and is the farthest south. (Plate II.) It has an area of 4,210 square miles. Its general shape is very much that of a regular triangle, with the base to the southeast and the apex extending toward the northwest. The surface of the island is broken by four high mountains, or rather volcanoes. Near the center is the active crater of Mauna Loa, having an elevation of 13,675 feet. This volcano has been recently active (from July 4 to 24, 1899). It has shown a tendency to eruption quite often during the past decade. North of this volcano and nearer the northern part is the crater of Mauna Kea, having an elevation of 13,805 feet. About equally distant from this and Mauna Loa, and lying east of the latter, is the crater of Kilauea, having an elevation of 4,040 feet. This is considered the largest active volcano in the world. It is at the present time emitting volumes of steam, but is not active in the sense of emitting a lava flow. About equally distant from Mauna Kea and Mauna Loa, and in a north-

westerly direction from the latter, is the volcano Hualalai, having an elevation of 8,273 feet. In the northwestern extremity of the island are the Kohala Mountains, with an elevation of 5,505 feet. These mountains extend in a northwesterly direction to the apex of the island, crossing from the North Kohala to the South Kohala district. From all these volcanoes we find large beds of lava flow, which are more or less in a state of disintegration, giving rough surfaces to the ground surrounding them, and on some of which vegetation has started and forests have grown, indicating a longer period since activity of the volcano.

From Mauna Loa volcano, radiating in northwesterly, northerly, easterly, and southerly directions, are five distinct lava flows, occurring at different dates, which have covered a large scope of country that would otherwise be mostly good, tillable ground. These lava flows are of recent date and are readily discernible by referring to the map (Plate II).

The coast line of this island is marked by several indentures, giving quite a number of bays and two or three harbors where the smaller ships and steam vessels may land, and one main harbor, that of Hilo, situated on the eastern extremity. While this harbor is capable of taking in the larger ships, the present wharf facilities do not permit it. Much of the sugar of this island goes direct to market ports, while the rest of it, along with the cattle which are raised in great abundance in this island, is shipped to the port of Honolulu, and from there the sugar is exported.

This island has a number of small streams, but inasmuch as sugar is grown entirely by rainfall they are hardly worth considering in this connection.

On the southeastern and, to some extent, on the eastern, border of the island, shading back from the coast to the mountains, are large areas of forest which forms a dense growth, sometimes a jungle. In these forests are some large trees, apparently of considerable age, and, I am told, of superior quality for lumber for interior finishing and cabinet work, resembling mahogany very much in grain and color. It is known as koa. It is of interest in this connection to note the fact that these forests are more or less useful for sheltering the plantations from the influence of winds, and the further fact that the possibility of increasing the sugar lands lies in clearing off and using these lands. There is a plantation 14 miles from Hilo where an expenditure of $1,000,000 is being made simply in clearing out the forests and putting the land in shape for plantation use.

The rainfall on this island is extensive. The average annual rainfall for 1898–99, observation of 21 stations, was 86 inches. The tendency of the rainfall on the eastern and southeastern coasts is to fall in large volumes and somewhat irregularly, but on the western coast it is more regular throughout the year and of less volume. The elongated northeastern coast is the windward side of the island, and the western

and southeastern coasts the lee side. The occasion of the unusual rainfall is the high elevation of the two volcanoes already mentioned, Maunea Kea and Mauna Loa, on which snow rests the year round. These cool the moisture-laden trade winds and cause the tremendous rainfall on the windward side of the island, but give a more moderate and regular rainfall on the lee side. The protection given by the mountain elevations and forests gives to the island the hot tropical climate and the excessive moisture so conducive to the sugar-cane production.

The effects of the salt spray, as a rule, are not felt so much on the windward side of this island on account of the abrupt, high, rocky shores. Beginning at the eastern point of the island and following around the windward side of the island, we find the plantations as follows:

PUNA SUGAR COMPANY.—This is simply a new plantation, just starting. In fact no ground has been planted yet. It is favorably situated and protected from the winds by heavy forests along the seashore. The soil is rich. There is a very warm and equable temperature. The elevation varies between 200 and 800 feet. Cane from this plantation will be transported to the mill by railroad, and sugar will be shipped from Hilo, and transported from the plantation to Hilo by railroad.

OLAA PLANTATION COMPANY.—This plantation is located in the district of Puna. It is protected from winds by heavy forests. The temperature is warm and equable. The elevation varies from 100 to 2,250 feet. This plantation is covered by heavy forests, and large acreage of it has to be cleared before planting. Cane from this plantation will be transported to the mill by railroad, and the product will be exported from Hilo by ship. This is a new plantation. Its equipment includes a 9-roller mill. Its daily capacity is 1,200 tons of cane or 170 tons of sugar.

WAIAKEA MILL AND PLANTATION COMPANY.—The total number of acres in this plantation is 15,000, of which 10,000 are cane lands. The number of acres cut last year was 2,060, and of growing cane, 4,500, while the number of acres available for future cultivation is 5,500. Last year 9,300 tons of sugar were produced, at the rate of 4½ tons per acre. The capital stock of the company is $600,000, all of it paid up. The number of shares is 6,000, each having a par value of $100.

Waiakea Plantation is located in the Hilo district, and is favorably situated, being protected from the winds by heavy forests along the seashore. Its elevation varies between 100 and 1,200 feet, averaging 500 feet. Plowing is done by mule power. The cane is transported to the mill by railroad and the sugar is loaded on the ships for exportation by scows direct from the mill. This has been a very successful plantation, and may be considered one of the best on the island of Hawaii. It is located one mile from Hilo. The water supply is rainfall, about 180 inches per annum. The plantation has about 124 miles (including

movable tracks) of private railway, 90 cars, and 3 engines. The capacity of the 9-roller mill is 60 tons of sugar per day. The percentage of the sugar extracted from the cane is 94.

HILO SUGAR COMPANY.—Last year 6,880 tons of sugar were produced. The capital stock of the company is $500,000, all paid up. It is divided into 5,000 shares of $100 each.

This plantation is also situated one mile from the city of Hilo in the district of Hilo. Beginning at the Waimea River, it extends northwest along the coast and west up to the mountains. This plantation is subject to the action of the trade winds; its temperature has modified attributes. Its elevation varies between 100 and 1,800 feet, but none of the cane along the coast is injured by spray. All cane is carried to the mill by flume and the product is transported by boat from the mill direct to the vessels for transportation to the coast. This is also a very successful plantation, being favorably situated for shipping, not greatly broken by gulches, and easily cultivated.

ONOMEA SUGAR COMPANY.—The amount of sugar produced in 1899 was 8,404 tons. The capital stock of the company is $1,000,000, all paid up. It is divided into 50,000 shares of $20 each.

This plantation is subject to the action of trade winds and the temperature is modified to some extent. The conditions found here are exactly the same as found on the plantation of the Hilo Sugar Company. The elevation is the same. The cane is flumed. The plantation has been and is successful. The sugar is transported from the mill by boat direct to Hilo Harbor for exportation. This plantation is located 8 miles from the harbor of Hilo.

PEPEEKEO SUGAR COMPANY.—The total number of acres owned by this company is 9,500, of which 3,500 acres are under cultivation. In 1899, 1,655 acres of cane were cut, and 7,450 tons of sugar were produced. The number of tons of sugar produced per acre was $4\frac{1}{2}$. The capital stock of the company is $750,000, all paid up. It is divided into 7,500 shares of $100 each.

This plantation is situated about 13 miles from Hilo. It is subject to the action of trade winds, which modify its temperature. The elevation is from 100 to 1,200 feet, the average being 600 to 700 feet. Mule power is used in plowing. The cane is transported to the 6-roller mill by flume, and the sugar shipped by boat direct to the port of Hilo for exportation. This has been a very successful plantation. Nine thousand acres are owned in fee simple and 500 acres leased. The water supply is natural rainfall, which is at the rate of about 130 inches per annum. There are 15 miles of flumes, and 1 mile of movable tracks and railway. The percentage of sugar extraction from the cane is 93.85 per cent.

HONOMU SUGAR COMPANY.—In 1899 4,968 tons of sugar were produced. The capital stock is $750,000, all paid up. The number of shares is 7,500 of $100 each.

This plantation is located in the Hilo district, about 15 miles from the port of Hilo. It is subject to the action of trade winds, which modify the temperature. The elevation varies from 100 to 1,800 feet. The cultivation is entirely by mule power. Cane is transported to the mill by flume. The sugar is transported from the mill direct to the port of Hilo for exportation by boat. This plantation has been very successful.

HAKALAU SUGAR COMPANY.—In 1899 the number of tons of sugar produced was 8,980. The capital stock of the company is $1,000,000, being all paid up. It consists of 10,000 shares of $100 each.

This plantation is located 18 miles from the port of Hilo, and is subject to the action of trade winds. The elevation varies between 100 and 2,000 feet. Mules are used in plowing. The cane is transported to the mill by flumes. The sugar is shipped by boat direct from mill to the harbor of Hilo for exportation. This plantation has been a great success.

LAUPAHOEHOE SUGAR COMPANY.—The total number of acres in the plantation is 4,500, of which 1,455 acres are owned in fee simple and 3,045 acres are leased. This land is all available for sugar production except about 200 acres. The amount of sugar produced in 1899 was 5,337 tons. The capital stock of this company is $250,000, all paid up. It is divided into 5,000 shares of $50 each.

Laupahoehoe plantation is located about 24 miles from the city of Hilo in the Hilo district. This plantation is also subject to the action of trade winds. Its elevation varies between 300 and 1,800 feet, averaging 850 feet. Cane is transported to the mill by flume, and the sugar by steamer to the port of Hilo for exportation. The plantation is cultivated entirely by mule power. The plant is a 7-roller mill, with a daily capacity of 45 tons of sugar. The percentage of sugar extraction from cane is 90 per cent.

OOKALA SUGAR COMPANY.—In 1899 3,564 tons of sugar were produced. The capital stock of this company is $500,000, all paid up. It consists of 25,000 shares of $20 each.

Ookala plantation is located about 30 miles from the city of Hilo. It is subject to the action of trade winds. The cultivation is by mule power. The cane is transported to the mill from the fields by fluming and railway—by fluming from the upper fields and by the railway from the lower fields. The sugar is transported by steamer to Honolulu for exportation.

KUKAIAU PLANTATION COMPANY.—In 1899 the number of tons of sugar produced was 1,732. The capital stock is $120,000, all paid up. The par value of stock per share is $100, and the number of shares 1,200.

This plantation is located 38 miles from the city of Hilo. It is subject to the action of trade winds. Its elevation varies between 100 and 1,800 feet. Cultivation is by mule power and the cane is brought to the mill by cable. The sugar is shipped from the mill to the port of

Hilo by steamer, whence it is exported. The Kukaiau mill is owned by the Kukaiau Plantation Company.

HAMAKUA MILL COMPANY.—The total number of acres in this plantation is 11,000, of which 9,500 acres are owned in fee simple and 1,600 leased. Of this, 4,500 acres are capable of cultivation. The number of acres now under cultivation is 3,400. The amount of sugar produced in 1899 was 6,000 tons, at the rate of 3½ tons per acre. It took 8 tons of cane to produce one of sugar.

The capital stock of this company is $500,000, all being paid up. The par value of the stock per share is $100, and the number of shares 5,000.

This plantation is located 40 miles from the city of Hilo, in the district of Hamakua. It is subject to the action of trade winds. Its elevation varies between 100 and 2,000 feet, averaging 800 feet. Plowing is done by mule power and cane is transported to the mill by mule power and railroad. Two steam plows are operated. Sugar is transported from the mill to the port of Honolulu, and thence exported. Water supply is rainfall, the annual rainfall being 60 inches. Of private railroad, including movable track, there are 9 miles. The daily capacity of the 9-roller mill is 60 tons of sugar.

PAAUHAU PLANTATION COMPANY.—In 1899 the number of tons of sugar produced was 7,529.

The capital stock of the company is $5,000,000, all paid up. It is divided into 100,000 shares of $50 each.

This plantation is located 45 miles from the port of Hilo. It is subject to the action of trade winds. It is cultivated by steam plows and mule power. Cane is transported to the mill by railway. The sugar is transported by steamer from the plantation to Honolulu for exportation. The plantation is successful.

HONOKAA SUGAR COMPANY.—This plantation contains 7,500 acres, of which 3,500 are owned and 4,175 leased. The total number of available acres is 6,000, of which there are now under cultivation 5,320, leaving available for future cultivation, 680 acres. In 1899 9,150 tons of sugar were produced. The capital stock is $2,000,000, all paid up. The par value of stock per share is $20, and the number of shares 100,000.

This plantation is subject to the action of trade winds. Its elevation is from 100 to 1,600 feet, averaging 840 feet. Cultivation is entirely by mule power. Cane is transported to the mill by railway. Sugar is transported by steamer to Hilo for exportation. This may be considered one of the successful plantations on the island of Hawaii. Its water supply is from rainfall, the annual precipitation being 72 inches. There are 5 miles of movable railroad track and 2 miles of flumes. The plant includes a 9-roller mill. The percentage of sugar extracted from the cane was 93 per cent.

PACIFIC SUGAR MILL COMPANY.—This company has a plantation of 9,400 acres, of which it owns 6,400 and leases 3,000. Of this area 3,800 acres are available for cane growing. The number of acres now under cultivation is 3,200, leaving 600 acres available for future cultivation. In 1899 4,640 tons of sugar were produced. The capital stock of the company is $500,000, all paid up. It is divided into 5,000 shares of $100 each.

This plantation is located 50 miles from the city of Hilo in the Hamakua district. It is subject to the action of trade winds. Its elevation varies from 300 to 1,600 feet, averaging 740 feet. Plowing is done by mule power. Cane is transported to the mill by mule power and railway. Sugar is transported by steamer from plantation to Hilo for exportation. This also may be considered a successful plantation. The moisture supply is from rainfall, which averages 50 inches annually. There are 2¼ miles of private railway, including movable track, and 6 miles of flumes. The plant includes a 9-roller mill. Its daily capacity is 490 tons of cane and 60 tons of sugar. The percentage of sugar extraction from the cane is 93 per cent.

NIULII MILL AND PLANTATION.—In 1899 this company produced 2,226 tons of sugar.

This plantation is located in the district of Kohala, 20 miles from the port of Mahukona. It is subject to the action of trade winds. Some of the cane on the lower fields is occasionally damaged by salt spray. The elevation varies from 100 to 500 feet. Cultivation is by mule power. The cane is transported to the mill by flume and mule power. Sugar is transported by rail from the mill to the port of Mahukona for exportation to San Francisco. This plantation is considered successful.

HALAWA SUGAR COMPANY.—This plantation produced 1,049 tons of sugar in 1899. It is about 17 miles from the port of Mahukona. It is subject to the action of trade winds. The elevation varies from 100 to 1,800 feet. Plowing is done by mule power. Cane is transported to the mill by flume and by mule power. Sugar is transported to the port of Mahukona and from there exported to San Francisco. This may be considered a successful plantation.

KOHALA SUGAR COMPANY.—This plantation contains 4,218 acres, of which the company owns 3,554 and leases 664. Of this area 2,800 acres are available for cane growing, 2,650 being now under cultivation. In 1899 4,100 tons of sugar were produced, at an average of 3 tons of sugar per acre and 7.5 tons of cane to one ton of sugar. The capital stock of this company is all paid up. It consists of 960 shares of $500 each. This plantation is situated about 15 miles from the port of Mahukona. It is subject to the action of trade winds, and some of the cane on the lower fields is occasionally damaged by salt spray. The elevation ranges from 100 to 1,800 feet, averaging 500 feet. Cultivation is by mule power. Cane is brought to the mill by mule power and by fluming. Sugar is transported by rail to the port of Mahukona for

exportation to San Francisco. The water supply source is rainfall, the annual average being 57 inches. This is a successful plantation. There are 6 miles of flumes. The plant includes a 9-roller mill. The daily capacity is 350 tons of cane, or 50 tons of sugar. The percentage of sugar extracted from the cane is 94; the net percentage of marketable sugar is 86.75.

UNION MILL COMPANY.—In 1899 1,668 tons of sugar were produced. The capital stock is $200,000, all paid up. The par value of stock is $100 per share, and the number of shares 2,000.

The Union Mill Company's plantation is located about 12 miles from the port of Mahukona. Trade winds prevail. The elevation is from 100 to 1,800 feet. Cultivation is done by mule power. Cane is transported to the mill by mule power. The sugar is transported by rail to the port of Mahukona for exportation to San Francisco.

HAWI MILL.—In 1899 this company produced 1,222 tons of sugar. It is located 10 miles from the port of Mahukona. The plantation is subject to the action of trade winds. The elevation varies between 100 and 1,800 feet. Plowing is done by mule power. The cane is transported to the mill by mule power, and the sugar is shipped by mule teams from the mill to the port of Honoipu for exportation to San Francisco.

BEECROFT PLANTATION.—This is a part of the Hawi mill, and the conditions prevailing are the same as at the Hawi mill plantation. This plantation produced 609 tons of sugar.

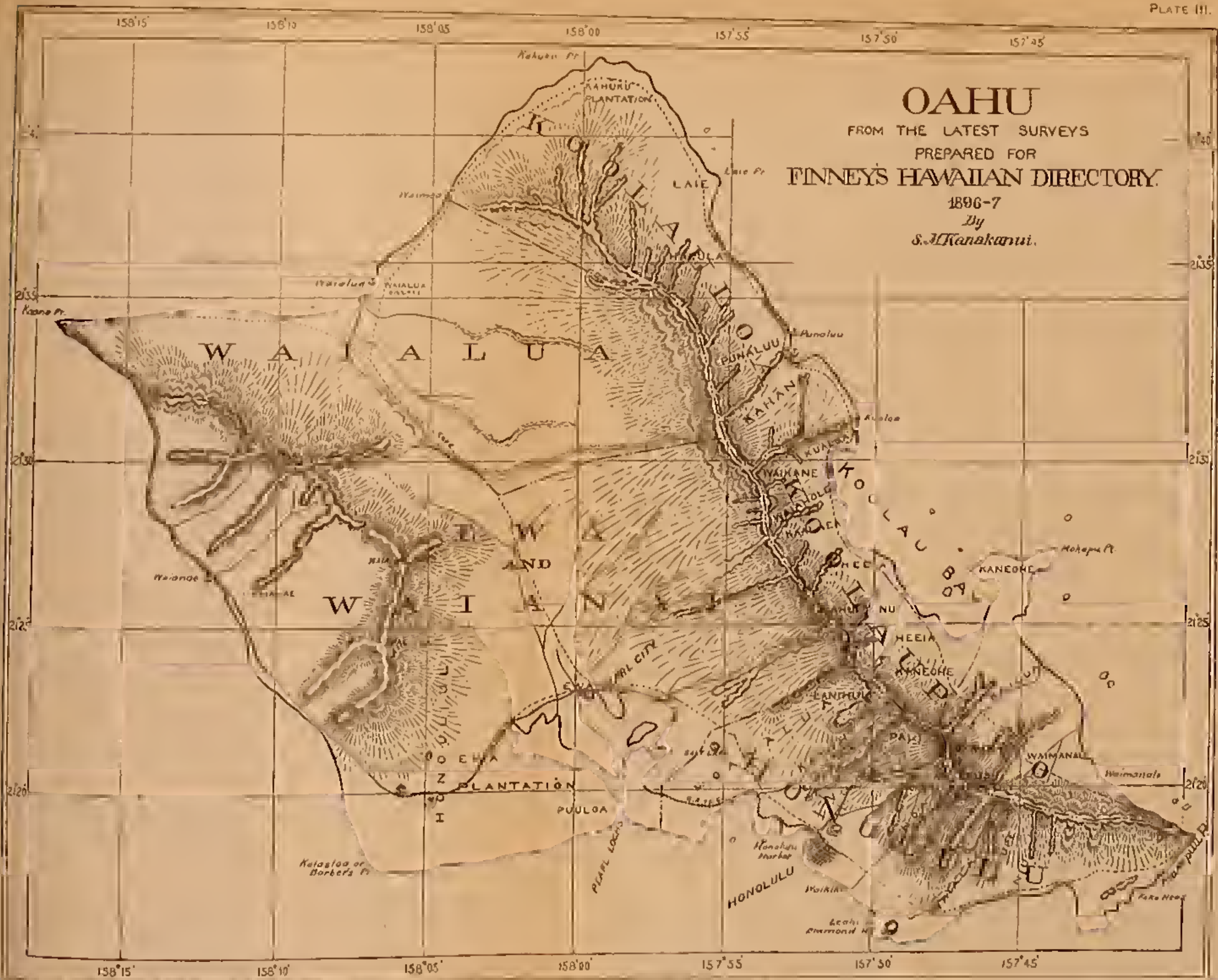
KONA SUGAR COMPANY.—The capital stock of this company is $500,000, of which $180,000 is paid up and $320,000 is assessable. The par value of the stock per share is $100 and the number of shares 5,000.

This plantation brings us around the northwestern point of the island to the lee side, to the port of Kailua Bay, about half way along the western border. Kona plantation is protected from the winds. Warm, equable temperature prevails. The elevation varies from 400 to 2,800 feet. Rain is distributed through the season. The soil has fine color, but the surface is rough and stony. Stalks of experimental sugar cane have grown to a height of 24 feet on this plantation. This is a new plantation, just being reduced to a state of cultivation. No sugar has yet been produced from it, but prospects are good for a successful plantation.

HUTCHINSON SUGAR PLANTATION COMPANY.—In 1899 this company produced 7,732 tons of sugar. Its capital stock is $2,500,000. The par value of the stock is $50 per share, and the number of shares 50,000.

This carries us around the southern extremity of the island to the small port of Honuapo, which is on the eastern border and also on the lee side. This plantation is protected from the winds. The climate is warm and equable. The elevation varies from 100 to 2,800 feet. Culti-

PLATE III.


OAHU
FROM THE LATEST SURVEYS
PREPARED FOR
FINNEY'S HAWAIIAN DIRECTORY
1896-7
By
S. M. Kanakanui.
WAIALUA
EWA AND WAIANAE
KOOLAULOA
KOOLAUPOKO
KONA
KAHUKU PLANTATION
LAIE
PUNALUU
KAHANA
KUALOA
WAIKANE
KANEOHE
HEEIA
WAIMANALO
PLANTATION
PUULOA
HONOLULU
Pearl Lochs
Honolulu Harbor
Waikiki
Leahi or Diamond Hd.
Kalaeloa or Barber's Pt.
Kaena Pt.
Kahuku Pt.
Laie Pt.
Punaluu
Kualoa
Mokapu Pt.
Waimanalo
Koko Head
Waianae
Waialua
158°15'
158°10'
158°05'
158°00'
157°55'
157°50'
157°45'

vation is by mule power. Cane is transported to the mill by flume. The sugar is transported from the mill by steamer to the port of Honolulu for exportation. This is a successful plantation.

HAWAIIAN AGRICULTURAL COMPANY.—In 1899 the number of tons of sugar produced was 11,318. The capital stock is $1,000,000, all paid up. It consists of 10,000 shares of $100 each.

This plantation is 9 miles from the small port of Honuapo, and is somewhat subject to the action of winds, which are local in their origin. The elevation varies from 600 to 3,000 feet. The cane is transported to the mill by flume and mule power. The sugar is transported from the mill by rail to Punaluu, thence by steamer to Honolulu for exportation. This plantation may be considered successful.

L. Chong is a planter on the Hawaiian Agricultural Company's plantation, operating as a leaseholder with this company. He produced 839 tons of sugar last year.

ISLAND OF OAHU.

This island is roughly pear-shaped, and extends nearly east and west, with the stem end toward the east (Plate III).

Beginning at the eastern extremity and extending in a northwesterly direction in close proximity to the coast is a continuous chain of mountains, varying in height from a few hundred feet to the highest point, which is Tantalus, 2,013 feet. Reaching from this general chain, at right angles on either side, toward the northwestern coast and toward the interior of the island, are many other lesser elevations caused by lava flows.

Beginning at the western extremity and running in a southeasterly direction for about a third of the distance is another chain of mountains having lateral elevations extending from it in the same way. These are known as the Waianae Mountains. The highest elevation is 3,050 feet. These mountain chains are well worth reviewing in considering the general economy of the agricultural resources of the island, inasmuch as they furnish protection from the trade winds, increase the temperature of given sections, and affect the moisture precipitation. They also cause countercurrents by means of draws, etc., which give the winds a local origin.

The coast line is considerably broken and cut by indentations. The largest harbor now in use in the island is that on the south coast, known as Honolulu. It is the general shipping port for all of the Hawaiian Islands. About 11 miles west of this is the harbor which the United States Government had secured in treaties with former Governments of these islands for the purpose of a coaling station. This harbor, when an entrance shall have been properly dredged, will be by far the best harbor in the islands, and it may be said to rank well with the leading harbors of the world on account of its natural arrangements. It is no doubt destined to figure some day as a great

harbor, lying, as it does, on the natural highway of commerce between the United States and the Orient.

Cane is grown on this island by irrigation, the water supply coming from surface water and artesian wells. It may be well to mention in this connection that throughout these islands there is always more or less of rainfall.

On this island between Diamond Head and Pearl City, on the lee side, are located near the edge of the sea a number of rice plantations occupied and cultivated by Chinese. On the windward side, beginning at Kaneohe and extending to Kahuku Point, are also a number of rice plantations occupying the lowland near to the edge of the sea. This is interesting in connection with the main industry—sugar production—from the fact that the large majority of laborers are Orientals who live largely on rice, the supply of which is partially furnished by local production. Rice production is also carried on to a small extent on the other islands.

As will be observed the windward side of the island is the northeast side, and the northwestern or the lee side is the larger portion of the island, extending from the most western extremity to the eastern extremity, forming a sort of crescent.

The average rainfall on the island for the past five years was about 42½ inches. Everything is exported from the main port of Honolulu.

I will describe these plantations in order, beginning at the eastern extremity, taking the windward side of the island first.

Waimanalo Sugar Company.—In 1899 the number of tons of sugar produced was 2,352. The capital stock of this company is $252,000, all paid up. The par value of the shares is $100, and the number of shares, 2,520.

This plantation is located on the windward side of the island and is subject to the trade winds, which materially affect the crops. The elevation varies from 50 to 400 feet. The method of cultivation is by steam power. The irrigation water is supplied by rainfall. Cane is transported to mill by railway. Sugar is transported from the mill by steamer to Honolulu for exportation. This plantation has always been successful.

Heeia Agricultural Company.—The amount of sugar produced on this plantation in 1899 was 2,190 tons. The capital stock of the company is $150,000, all paid up. It consists of 1,500 shares of $100 each.

Heeia plantation is located on the windward side of the island about 8 miles from Waiamanello. It is subject to the action of the trade winds. The elevation varies from 50 to 500 feet. Cane is transported to mill by mule teams and steam railway. The sugar is transported by steamer from the mill to the port of Honolulu for exportation. The plantation is successful. Cultivation is by mule power. The irrigation water comes from mountain streams.

LAIE PLANTATION.—The amount of sugar produced in 1899 was 494 tons.

This plantation is situated on the windward side of the island and is affected by the action of the trade winds. Its elevation varies from 50 to 400 feet. Cultivation is by mule power. The irrigation water comes from rainfall and artesian wells. Cane is transported to mill by rail from the fields; sugar is sent to the landing by rail and thence by steamer to Honolulu for transportation. This plantation is successful.

KAHUKU PLANTATION COMPANY.—In 1899 the amount of sugar produced was 7,008 tons. The capital stock of this company is $500,000; all of it paid up. The par value of stock per share is $100, and the number of shares, 5,000.

This plantation is subject to the trade winds. Cane is frequently affected by salt spray. The elevation varies from 100 to 650 feet. Cultivation is by steam plowing. Irrigation is by artesian wells and rainfall. Cane is transported to mill by steam railway. Sugar is transported by railway and steamer from mill to the port of Honolulu for exportation. This plantation is successful.

WAIALUA AGRICULTURAL COMPANY, LIMITED.—The number of acres of growing cane is 1,700. The amount of sugar produced last year was 1,700 tons. The number tons of sugar produced per acre was 5.43, and the number of tons of cane to one ton of sugar, 7. The capital stock of this company is $3,500,000, of which $1,500,000 is paid up and $2,000,000 is assessable. The par value of stock per share is $100.

This plantation may be considered as located on the lee side of the islands, and is protected from the trade winds. The climate is warm and equable. The elevation varies from 50 to 1,000 feet. The average elevation is 350 feet. Cultivation is by steam plowing. The supply of irrigation water comes from artesian wells and rainfall. The annual rainfall is 30 inches. Cane is transported to mill by steam railway. Sugar is shipped to Honolulu by rail from the mill for exportation. There are 16 miles of private railway, including movable track, and 6 miles of water flumes. Three sets of steam plows are operated. The percentage of sugar extracted from the cane is 94 per cent. This is a new plantation. Water is pumped to an elevation of 250 feet. The daily capacity of the water supply is 16,000,000 gallons. The plant includes a nine-roller mill with a daily capacity of 1,200 tons of cane and 150 tons of sugar.

WAIANAE COMPANY.—In 1899 the amount of sugar produced was 3,506 tons. The capital stock is $300,000, all paid up. It is divided into 3,000 shares of $100 each.

This plantation is located on the lee side of the island entirely protected by two high mountains extending out to the sea. The climate is very warm and equable. The elevation varies from 100 to 600 feet. Irrigation is by artesian wells and rainfall. Steam plows are used. Cane is transported to mill by steam railway. Sugar is shipped to Honolulu by rail for exportation. This plantation is successful.

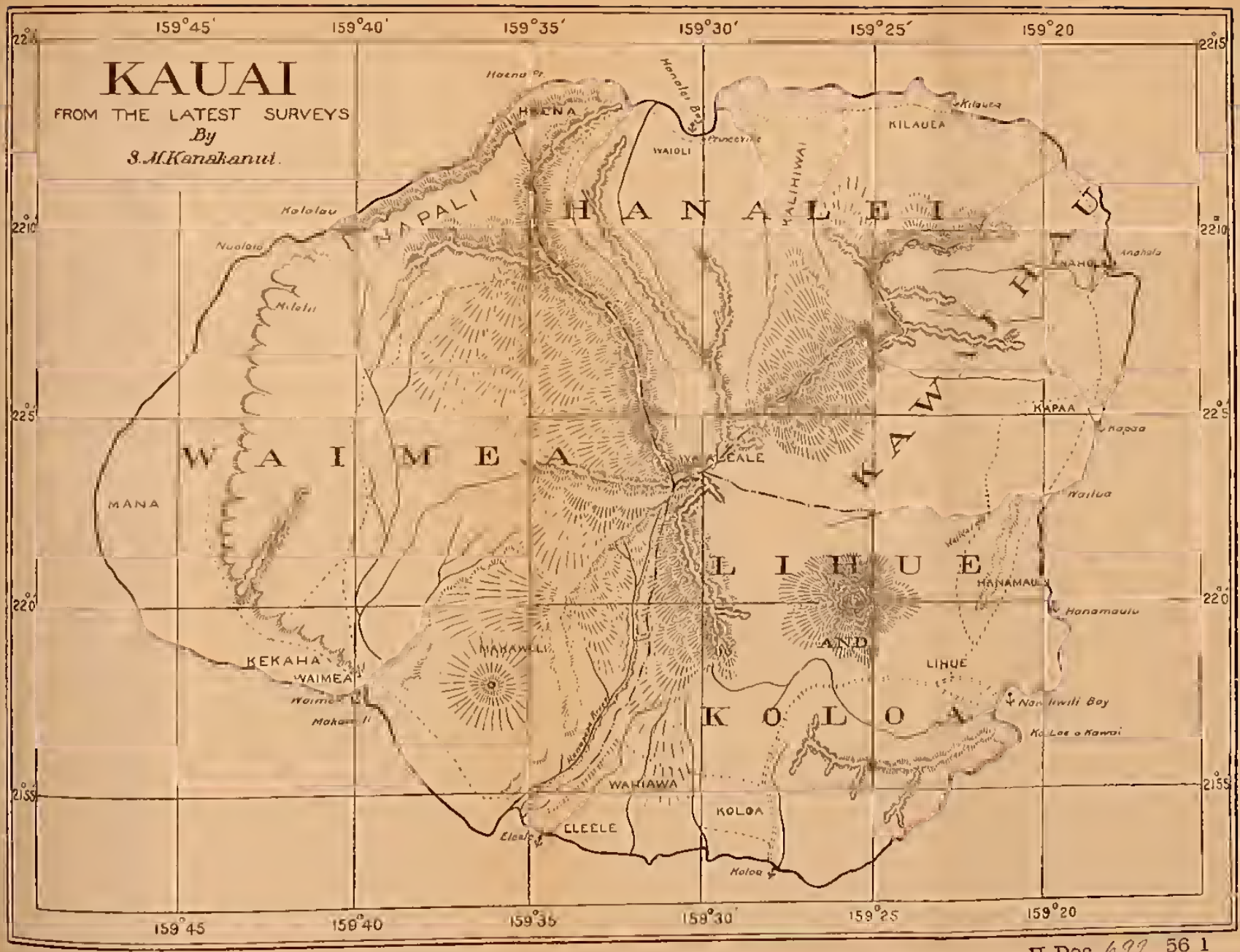
EWA PLANTATION COMPANY, LIMITED.—The total number of acres in this plantation (all leased) is 9,000. The total area available for production of sugar is 6,500 acres, of which 5,500 acres are producing cane, In 1899, the number of tons of sugar produced was 22,334. The number of tons of sugar produced per acre was 10.1, the amount of cane required to produce one ton of sugar being 7.83 tons. The capital stock of the company is $5,000,000, all paid up.

Ewa Plantation is located 10 miles from the city of Honolulu, near Pearl Harbor on the lee side of the island, and is protected from the winds by high mountains. The climate is warm and equable. There are 4 miles of flumes for water. The elevation varies from 40 to 200 feet, averaging 100 feet. Irrigation is by artesian wells and rainfall, the annual rainfall being 25.7 inches. Cane is transported to mill by steam railway, and the sugar is shipped to Honolulu from the mill by railway for exportation. There are 26 miles of private railway, including movable tracks. This plantation has been wonderfully successful, producing 10 tons of sugar per acre on an average. It operates 3 sets of steam plows. The percentage of sugar extracted from the cane is 93.5 per cent, the net percentage of marketable sugar secured being 83.25 per cent. The greatest elevation for pumping water is 200 feet, the daily water capacity being 52,000,000 gallons. The plant has a 9-roller mill with capacity of 1,000 tons of cane and 135 tons of sugar.

OAHU SUGAR COMPANY.—This company has 11,000 acres, of which it owns 1,500 and leases 10,500. The total number of available acres is 11,000, of which 3,500 acres are under cane growth. The total production of sugar in 1899 was 8,000 tons. The amount of sugar produced per acre was 8 tons, and the number of tons of cane to one ton of sugar was 8. The capital stock of this company is $3,600,000, of which $3,000,000 is paid up and $600,000 is assessable. The par value of stock per share is $100, and the number of shares 36,000.

Oahu Plantation is situated near Pearl Harbor on the lee side of the island. The climate is warm and equable. The elevation is from 100 to 650 feet. Steam plows are used. Irrigation is from artesian wells and rainfall, the annual rainfall being 20 inches. Cane is transported to mill by steam railway, and to Honolulu by rail for exportation. There are 25 miles of private railway, including portable tracks, and 1 mile of flume. Three sets of steam plows are used. This is a new plantation, but very successful, producing from 8 to 11 tons of sugar per acre of land. The daily capacity of the mill is 150 tons of sugar. The percentage of sugar extracted from cane is 93 per cent, the percentage of marketable sugar being 83 per cent. Water is pumped to an elevation of 550 feet. The daily capacity of water is 40,000,000 gallons. The plant includes a nine-roller mill.

HONOLULU SUGAR COMPANY.—The capital stock of this company is $900,000, being divided into 9,000 shares of $100 each. This plantation is located about 6 miles from Honolulu, and is the nearest planta-


KAUAI
FROM THE LATEST SURVEYS
By
S. M. Kanakanui.
159°45'
159°40'
159°35'
159°30'
159°25'
159°20'
22°15'
22°10'
22°5'
22°0'
21°55'
HANALEI
KALIHIWAI
KILAUEA
HAENA
WAIOLI
Hanalei Bay
Princeville
Kilauea
Haena Pt.
NAPALI
Kalalau
Nualolo
Milolii
WAIMEA
MANA
KEKAHA
WAIMEA
Waimea
Makaweli
MAKAWELI
Waimea River
WAHIAWA
KOLOA
ELEELE
Eleele
Koloa
KAPAA
Kapaa
Wailua
LIHUE
HANAMAULU
Hanamaulu
AND
LIHUE
Nawiliwili Bay
Ke Lae o Kawai
KAWAI
KAU
Anahola
NAHO

tion to that city. It is on the lee side of the island. The climate is very warm and equable. Steam plows are used; also steam railway. Irrigation water is supplied by artesian wells and rainfall. The cane will be shipped to Honolulu by rail, and from this port exported. This is a new plantation of promise.

ISLAND OF KAUAI.

The general shape of this island is like a pear, with the smaller end extending toward the west (Plate IV). This is generally conceded by geologists to be the oldest island in the group. Directly in the center of the island appears an extinct volcano called Waialeale. Radiating from this volcano are chains of mountains extending east, west, north, and south. The windward coast of this island is the northern and eastern sides, and the lee side is the southern coast. The coast line is not so much broken as in the case of the other islands. There are a few small harbors, but the sugar produced on this island is shipped to Honolulu by steamer and thence exported.

Beginning at the northeastern extremity and going around the eastern side of the island first, then around the southern, passing around the western end, and back to the place of beginning, the plantations will be taken up in the order in which they occur.

KILAUEA SUGAR COMPANY.—In 1899 this company produced 5,420 tons of sugar. Its capital stock is $300,000, all paid up. The par value of stock per share is $1,000, and the number of shares 300.

The plantation of this company is located on the lee side of the island. Its elevation is from 100 to 600 feet. Cultivation is by steam and mule power. Irrigation water is supplied by mountain streams. Cane is transported to mill by steam railway and sugar is transported to Honolulu by steamer for exportation. This is a successful plantation.

MAKEE SUGAR COMPANY.—In 1899 a total of 9,350 tons of sugar was produced. The capital stock of the company is $500,000. This plantation is located on the windward side of the island, and is subject to the action of trade winds. The elevation varies from 100 to 800 feet. Steam plows are used. Irrigation water is supplied by mountain streams and artesian wells. Cane is transported to mill by fluming and steam railway. The juice is extracted from the cane by the diffusion process. Sugar is transported to Honolulu for exportation. The plantation is successful.

LIHUE PLANTATION COMPANY.—This company has a plantation of 34,000 acres, of which it owns one-half and leases the remainder. Only 7,000 acres are available for sugar production. Cane is now growing on 4,000 acres. In 1899 16,000 tons of sugar were produced. The amount of sugar produced per acre was $5\frac{1}{3}$ tons. The number of tons of cane required to produce one ton of sugar is $7\frac{2}{5}$. The capital stock of this company is $1,400,000, all paid up. The par value of stock per share is $100, and the number of shares 14,000.

Lihue Plantation is located on the windward side of the islands. Its climate is subject to the action of trade winds. Its elevation varies from 40 to 400 feet. Cultivation is by steam plowing and mules. Irrigation water is furnished by mountain streams and rainfall. The annual rainfall is 45 inches. Cane is transported to mill by steam railway. Sugar is transported to Honolulu by steamer for exportation. The plantation is successful. There are 35 miles of private railway, including movable track. The elevation to which water is pumped is 80 feet. The daily capacity of water is 2,000,000 gallons. The plant includes one 9-roller mill and one 12-roller mill. The daily capacity is 2,000 tons of cane and 250 tons of sugar.

Grove Farm Plantation.—The conditions prevailing here are exactly the same as on Lihuē Plantation; the cane is grown in the same way and ground at the Lihue mill.

Koloa Sugar Company.—This company has an area of 12,257 acres, of which it owns 6,257 and leases 5,000 acres. The land available for cane growing is 2,413 acres. In 1899 a total of 5,268 tons of sugar was produced. The number of tons of sugar produced per acre was 5.31. The capital stock of the company, $300,000, is all paid up, and is divided into 3,000 shares of $100 each.

This plantation is located on the lee side of the island. Its elevation varies from 50 to 350 feet. Cultivation is by steam plowing. Irrigation water comes from mountain streams. The annual rainfall is 50 to 60 inches. Cane is transported to mill by mule power and steam railway. Sugar is shipped to Honolulu by steamer for exportation. This plantation has been successful. There are 12 miles of private railway, including movable track, and one set of steam plows. The elevation to which water is pumped is 150 feet, and the daily water capacity is 5,000,000 gallons. The plant includes an 8-roller mill. The daily capacity is 40 tons of sugar.

McBryde Sugar Company.—This company has 18,350 acres, of which it owns 6,000 and leases the rest. Cane is now growing on 1,728 acres, and the number of acres available for future cultivation is 6,218. In 1899 the amount of sugar produced was 1,200 tons, the amount of sugar produced per acre 7 tons, and the amount of cane to 1 ton of sugar 7½ tons. The capital stock of the company is $3,500,000, of which $1,650,000 is paid up and $1,850,000 is assessable. The par value of the stock per share is $20. Dividends to the amount of $175,000 have been declared.

This is a new plantation. Its elevation varies from 100 to 600 feet, averaging 400 feet. Irrigation water comes from artesian wells and rainfall. Cultivation is by steam plowing. Cane is transported to mill by steam railway. Sugar will be transported to Honolulu for exportation. There are 2½ miles of private railway, including movable track, and 1,000 feet of flumes. There are two sets of steam plows. The elevation to which water is pumped is 250 feet. Daily water capacity

is 17,000,000 gallons. The plant includes a 7-roller mill of 40 tons of sugar daily capacity.

HAWAIIAN SUGAR COMPANY (KNOWN AS MAKAWELI).—In 1899 the amount of sugar produced was 14,350 tons. The capital stock of the company is $2,000,000, all paid up. The par value of the stock per share is $100, and the number of shares 20,000.

This plantation lies on the lee side of the island. Its elevation varies from 100 to 1,000 feet. Irrigation water comes from mountain streams. Cultivation is by steam plowing. Cane is transported to mill by steam railway. Juice is extracted from the cane by the diffusion process. Sugar is transported by steamer to Honolulu for exportation. This plantation is most successful.

Messrs. Gay & Robinson have a plantation on which cane is grown under the same conditions as on the Hawaiian Sugar Company's plantation, being worked up by that company's mill.

WAIMEA SUGAR MILL COMPANY.—The amount of sugar produced in 1899 was 1,021 tons. The capital stock of the company is $125,000, all paid up. The par value of the stock per share is $100 and the number of shares 1,250.

This plantation is located on the lee side of the island. Its elevation ranges from 100 to 500 feet. All cultivation is done by mule power. Cane is transported to mill by mule power and steam railway. Sugar is transported to Honolulu by steamer for exportation. Irrigation is from artesian wells.

KEKAHA SUGAR COMPANY.—The number of acres now under cane is 1,800. In 1899 the amount of sugar produced was 7,600 tons; the number of tons of sugar produced per acre was 5.96, and the number of tons of cane to 1 ton of sugar, 8.5. The capital stock of this company is $600,000, all paid up. It is divided into 6,000 shares of $100 each.

This plantation is located on the lee side of the island. Its temperature is very warm and equable. Its elevation is from 10 to 80 feet, the average being 30 feet. Cultivation is by steam plowing. Irrigation water comes from artesian wells. Cane is transported to mill from the field by steam power. Sugar is transported to Honolulu for exportation. There are 16 miles of private railway and movable track. Two sets of steam plows are operated. The elevation to which water is pumped is 80 feet. The daily water capacity is 18,000,000 gallons. The plant includes a 9-roller mill, with a daily capacity of 450 tons of cane and 55 tons of sugar.

The estate of V. Knudsen is a plantation on which cane is raised the same as at the Kekaha, and ground at the Kekaha's sugar mill.

THE PRINCEVILLE PLANTATION COMPANY.—This is located at Hanalei Bay on the lee side of the island. This plantation is now lying idle. The mill was formerly a diffusion one. The plantation was not successful, and the lands have been transformed into a cattle ranch.

Estimated Cost and Profits of Sugar Production in the Hawaiian Islands.

An estimate of the actual cost of producing sugar in the Hawaiian Islands would be an interesting item for the perusal of those engaged in sugar manufacturing in other sections of the country. Detailed information on this point is hardly obtainable under the present condition of things, inasmuch as it is private matter, not appearing in public reports or publications, and usually consists only of estimates made by the plantation managers for the benefit of the directors and manipulators of each particular concern. An occasional item of information, pretty well authenticated, sometimes leaks out, and serves to throw some light upon the subject. I give here some figures of this kind, which I consider quite reliable. They were made by a new company which is opening up an extensive plantation. These figures were used as a basis for estimating the probable future costs and profits of productions. The figures themselves were deduced from the actual operations of plantations where the conditions were quite similar to those affecting the new concern.

As the public is not interested in knowing the names of the particular plantations, I will designate the new concern as No. 1, and the other plantations as Nos. 2, 3, 4, 5, 6, and 7, respectively. The following table shows the crop of sugar for 1898, total profits, cost per ton of sugar, and profits per ton of sugar:

Cost of producing cane sugar in the Hawaiian Islands in 1898.

Company.	Total product of sugar in tons.	Total profits for season.	Cost per ton of sugar.	Profits per ton of sugar.
No. 2	7,763	$199,998	$44	$25
No. 3	8,400	276,227	35	34
No. 4	6,914	243,557	34	35
No. 5	4,932	138,259	41	28
No. 6	6,198	198,991	37	32

Another plantation which will be designated No. 7, produced 20,000 tons of sugar at a cost of $22.50 per ton. This is the very lowest cost of production reported, as this is the ideal plantation as to amount of sugar produced per acre at a minimum cost. This plantation started with an original capitalization of $1,000,000. The profits of the concern were so great that the original capital stock was taken up and in its place $5,000,000 of stock was issued; that is, the original capital was multiplied by five, making $5,000,000 paid-up capital. Rating the selling price of sugar at $69 per ton as in the above table, and the cost of production at $22.50, this plant would yield a profit of 9 per cent on this expanded capital.

It was estimated by the new company, No. 1, that they would be able to cut annually about 8,000 acres of cane, which would yield 6 tons of sugar per acre, making the annual output of sugar 48,000 tons. They

figured their cost of production $30 per ton of sugar, giving them a profit of 38 per cent on their $5,000,000 capital. They estimated the selling price of sugar at $70 per ton. If the cost of production should run up to $35 per ton and the selling price remain $70, then the profit would be 33¼ per cent. If the cost of production should remain $30 per ton and the selling price of sugar should go down to $60 per ton, then the profit would be 28⅘ per cent. If the cost of production should be $35 per ton and the selling price of sugar $60 per ton, the profit would be 22 per cent. If the cost of production should be $30 per ton and the selling price of sugar $50 per ton, the profit would be 19 per cent. If the cost of production should be $35 per ton and the selling price of sugar $50 per ton, then the profit would be 14 per cent.

The capital stock of the concerns in the foregoing table will now be shown with the total profits and the percentage of profits.

Profits of some sugar companies in the Hawaiian Islands in 1898.

Company.	Capital stock.	Total profits.	Per cent of profit.
No. 2	$600,000	$199,998	33⅓
No. 3	500,000	276,227	54¼
No. 4	750,000	243,557	32.47
No. 5	750,000	138,259	18.43
No. 6	2,000,000	198,991	9.94½

The foregoing table would indicate a good earning power of the capital invested in these plantations, but it must not be taken for granted that all the plantations in the Hawaiian Islands are doing as well. Most of the plantations are getting a good return, however, on their investment at the present prices of sugar. The plantations whose figures are used are fortunately located. Their supply of moisture is the cheapest (natural rainfall) and very bountiful.

SETTLED CONDITIONS.

There are conditions that permanently affect the cost of production of sugar in these islands. As these conditions have already been described more or less fully, it is only necessary to enumerate them here.

It takes, on an average, two years to produce a crop of cane.

The cane lands must be fertilized regularly and more or less heavily, and the fertilizers must be imported.

A large part of the acreage of cane must be grown by irrigation. Where surface water is insufficient, artesian wells and pumping must be relied on, but the altitude to which water can be raised in this way is limited, and the limit has probably been reached already in some sections.

The general markets for sugar are far distant and transportation is expensive.

CONDITIONS WHICH WILL TEND TO INCREASE COSTS.

Unskilled labor performed on the plantations and in the mills in the production of sugar on the islands is almost entirely done by four classes, as follows: Portuguese, Japanese, natives, and Chinese. The desirability of these different nationalities for work on plantations seems to run in the order which I have named them. It will be seen from the table on page 127 that this is the order according to wages paid. I desire to discuss under this head the prospect for a future rise in the wages. It will be seen by the tables on page 128 that the greater portion of these laborers are Asiatics, there being many more Japanese than Chinese. Almost all of the laborers were brought to the islands originally under contracts. A contract laborer is one who signs a contract agreeing to work for his employer for a stipulated sum for a stipulated time, on condition that the employer pay the expenses of transportation and furnish him a place to live, he boarding himself. Usually the time stipulated in these contracts is three years, and the wages $12 to $15 per month. There are other conditions in these contracts, and, in addition, the laws made by the Hawaiian Government give the planter almost entire control of the contract laborer's actions. He can be punished and imprisoned and made to work; and the planter has the power to decide whether or not he is able to work and other powers which make peculiar reading under the jurisdiction of the Stars and Stripes. The contract laborer himself is known as a "coolie." From a moral or an intellectual standpoint he would not rank very high. I have seen them unloaded and "corralled" by the hundred. It is hard to imagine that any country could furnish so many human beings so illy equipped for civilized life. These people, as they arrive, are usually dressed in a single loose garment without other clothing except some form of sandals, and possibly a blanket. They present themselves as future wage-earners, possibly citizens, at least servants, to participate in the island affairs. Of course these are crude workmen—no wonder their pay is so little—but after three years apprenticeship they are supposed to become more or less skilled, free to hire out as day laborers, go into business for themselves, or return to the country they came from. Under the laws of the United States which take effect June 14, 1900, no more Chinese laborers can come in, no more contract laborers can come, and all that are there simply become day laborers. If any additional Chinamen come it can only be merchants, students, or travelers, and, as an element of the population, the Chinese will gradually become scarce. Some will die and some will return to their native land. If any additional Japanese come, of course it will be such as can pay their own expenses—a better class, who will demand higher wages, so that as these lower-class Chinamen and Japanese decrease in numbers wages will become higher, the same as they did in California. This change will begin immediately, as the demand for labor of all kinds is expanding at a wonderful rate in the

islands. The history and conditions in this case are exactly the same as those of California, and it will be but a short time until they will be paying in the Hawaiian Islands the same wages for the same kind of service as is paid in California to-day.

As business of all kinds increases in the islands other industries will compete with the sugar industry in the demand for labor. If the cost of unskilled labor shall come up to a level with the cost of the same in the States, then the cost of labor to the Hawaiian sugar producer will have increased about two-thirds.

It is interesting in this connection to investigate some statistics which appear in Thrum's Annual for the years 1897–98. These statistics are used officially in the islands. In making a comparison of the number of tons of sugar to each laborer employed agriculturally and in the manufacture of the product, he gives the following:

1897, 9⅛ tons of sugar to each laborer employed on the plantation or in the mill.
1898, 10½ tons of sugar to each laborer employed on the plantation or in the mill.

The same authority gives the average wages paid on plantations as $18 a month, or $216 per year.

Suppose we take ten tons of sugar as the average amount produced per man during the years 1897 and 1898, then the labor cost of producing one ton would equal $216 divided by 10, or $21.60.

If the average wages in California are $30 per month, and the average wages in Hawaii increase from $18 to the California level, the change will involve an increase of 66⅔ per cent. The increase in the labor cost of a ton of sugar will be $14.40 and the labor cost of a ton of sugar will be $36. If the average total cost of producing a ton of sugar in the islands at present is $40, the additional labor cost of $14.40 will increase the total cost of producing sugar in the islands to $54.40 per ton, and the increase in the entire cost of production on account of this increased cost of labor will amount to 36 per cent.

The tendency of these companies to expand their capital stock to the highest limit furnishes another item of cost in production, which will not only make the cost of production higher than it has been hitherto, but it will have a tendency to fix this item permanently for the future. While the stock of these companies is listed as "all paid up," this does not necessarily mean that an amount of cash equal to the face value of the stock has been invested. It simply implies that the holder of the stock is not liable to assessment. In many cases the amount of the stock of a company is greatly increased by new issues which do not represent any new investment of capital whatever. I have already called attention to a concern whose profits were so large that the company called in the original capital stock and expanded it by issuing new shares of stock for five times the previous amount. This is probably the most radical move that has been made in this direction by any company, but as a rule the tendency has been to expand the capital stock as far as the profits in the case would justify. Where this has not already been accomplished it is being arranged for wherever possible.

As a factor of cost in the future production of sugar this change operates as follows: The investment of capital in any concern must always be reckoned with as having an earning power. The operators of any business in making out their annual statements must count in as one of the items in cost of production a fair compensation for the capital employed. It is plain that this item will be larger as the capital is expanded. In the case of the concern mentioned previously, this item will be five times as large as it would have been in the first instance. It will not do to say that a part of the capital is fictitious, and that it was the smaller capital that earned the profits because a great deal of this capital stock goes onto the market and passes into the hands of bona fide purchasers at the market value based upon its earning power, so that in one sense the capital stock really represents the larger amount as an investment and must be so considered in the future in estimating the cost of production.

Another item that is well worth considering in this connection is the future productivity of the land that is constantly employed in growing a single crop. This land has to be heavily reenforced already by the use of fertilizers. It is a well-known doctrine of agriculturists that land deteriorates under the constant cultivation of a single crop, being called upon constantly for the same elements or plant food. It seems almost a certainty that these lands will have to be given longer periods of rest, or be used under some system of crop rotation, which in either case would lessen the amount of land available for sugar cane. Already rumors of this kind are more or less prevalent.

The lands controlled by these plantations are some of them owned in fee simple; others are held under long leases, some of them for fifty years. A considerable portion of the land is so held. This portion either belongs to large estates or is Government or "Crown" land. As the islands become more populous the value of these leased lands will increase. Much will depend on what may be the future policy with reference to the population of the islands, and upon this policy depends the future value of these leaseholds, and, in my opinion, the future utility of the islands themselves, so far as they shall bear a part in carrying out the function of our free American government, which I understand is to bring to each individual as much comfort, intelligence, and opportunity for a happy home life as it is possible for a government to accomplish.

Some of these leaseholds will soon expire, and, as has been stated, some of them are on lands under the control of the Government. The policy adopted in the future may be one which will bring these lands into the hands of small holders, who would, as is the rule in this country, be men with families which they are trying to rear, clothe, feed, protect, and educate in the approved American fashion. This is a condition which the Americans as a rule would recognize as ideal. This condition would bring the most and best population, the most wealth, peace, and happiness to the greatest number of people. On the other hand, the

policy adopted may be such that these lands may be again controlled or owned in large tracts by the plantation companies. In this case the citizenship will be largely limited, so far as the rural districts are concerned, to hired laborers on the plantations without families. This condition would mean the most wealth for the sugar industry, and this is the principal industry.

The future maximum production of the islands, among those who have given this subject consideration, ranges in estimate between 450,000 and 500,000 tons. A large portion of this can be produced at a large profit. When the actual cost of pumping water for irrigation to higher altitudes shall have been determined, then it will be possible to get at the earning rate of the various kinds of land on the islands. Probably all the lands estimated for the future production of the maximum 500,000 tons will produce cane at a profit, providing there is no fall in the sugar market, but not over half or three-fifths of this maximum can be produced at a cost nearly so low as the average cost of production in the islands at the present time.

It has been my attempt in this discussion on the cost of production of sugar in the Hawaiian Islands to give the facts, possibilities, and probabilities. The resources of the Hawaiian Islands for producing sugar are wonderful. I was impressed with the gentlemanly demeanor and the business sagacity and tact of those representing the sugar interests there. It has undoubtedly required men of energy to build up this industry as it has been done in the last twenty-three years. They have been men of business integrity. They have been able to induce millions of dollars of capital to invest in that country, and this capital has nearly always been able to find its reward. They have been men who have made a study of the best resources, methods, and appliances. They have had faith in their enterprises, and their faith has been rewarded. They have been specially favored; after many fruitless efforts, they finally succeeded in establishing reciprocity between the Hawaiian Islands and the United States in 1876. This was practically the beginning of their prosperity, as it gave them a free market near their shores for their chief product, sugar, and they had water transportation to this market. The volume of trade between the two countries was very favorable to them, as the imports per annum from the United States would not average in value over half the amount of products that we purchased from them. This trade balance with the States is still, and will be for some time, very much in their favor. The American people have from the beginning expressed satisfaction in the annexation of these islands, and have cheerfully allowed this advantage in trade. As the sugar industry is gradually developing in the States themselves, a desire for information as to the amount and cost of production in our new possessions, and other facts incident to the sugar industry, has been quite generally manifested, and this legitimate demand for information it has been my effort, within the limits of my opportunities, to satisfy.

Hawaiian Public Lands.

In the report of the Hawaiian commission appointed in pursuance of the "joint resolution to provide for annexing the Hawaiian Islands to the United States" will be found the following report on Government and Crown lands of the islands:

The frequent radical changes in the past years in the methods of control and of sales and leases and transfers of lands under the direction of the Crown—some made by royal order or grant, some by law, and some without much legality or formality—have made it very difficult to arrive at exact figures. We have, however, from the best sources available obtained the following statements, which are approximately correct, but subject to amendment when full opportunity may present for critica examination and computation.

In 1894 the Crown lands, or the lands formerly belonging to the Monarch, were taken over to the Republic of Hawaii. They amounted on May 1, 1894, to 971,463 acres, valued at $2,314,250. Those lands are now nearly all held by tenants under long leases, and for the year ending March 31, 1894, the rentals received were $49,268.75. The leases in force when the transfer of sovereignty from the Monarchy to the Republic took place have been recognized and the rental treated as Government income. As these leases expire the lands become available for settlement or lease, under the public-land system. An estimate by the Government September 30, 1897, of all Government lands and their value shows an aggregate of 1,762,330 acres, worth $4,147,700, to which is to be added the value of lots in Honolulu and Hilo—old lots unleased and sites of fish market, custom-house, and reclaimed lots—in all estimated at $1,481,000, making a total value of $5,629,500. Since September 30, 1897, and up to August 12, 1898, patent grants in fee simple conveying 8,860 acres of agricultural land valued at $48,500 have been issued, so that the present total area is 1,772.640 acres and the total value is $5,581,000.

Government lands in the Hawaiian Islands September 30, 1897.

Island.	Coffee.	Cane.	Rice.	Grazing.	Forest, etc.	Estimated value.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	
Hawaii	62,890	18,156	140	368,849	749,302	$1,874,900
Maui	8,180	520	110	112,570	58,550	453,800
Oahu	800	2,050	327	71,414	13,778	983,500
Kauai	4,400	4,900	400	80,050	86,650	648,000
Molokai				40,625		77,500
Lanai and Kahoolawe				77,669		70,000
Laysan, etc., Islands						40,000
Total	76,270	25,626	977	751,177	908,280	4,147,700
Building lots, Honolulu						521,800
Building lots, town of Hilo						160,000
Esplanade and city front:						
Leased lots (including esplanade storage) rent $27,000 per annum						450,000
Old lots unleased, including fish market, custom-house site, etc						250,000
Old lots (reclaimed land)						100,000
						1,481,800
Total value						5,629,500

According to a slightly different classification the total area of the government lands may be roughly stated as follows:

	Acres.
Valuable building lots	145
Cane lands	25,626
Rice lands	977
Coffee lands	76,270
Homesteads, government interest in	20,000

	Acres.
Grazing lands, of various qualities	451,200
Forest lands (high)	681,282
Rugged, inacessible mountain tracts	227,000
Barren lands of nominal value	300,000
Total	1,782,500

Some Hawaiian Statistics.

I desire to call special attention to the statistics furnished in the following tables, which give in a concise way information to which the public has had very little access before. These tables set forth the different nationalities of the people living on the various islands, with their relative numbers. They give the relative representation of the different nationalities who perform the labor on the sugar plantations and in the sugar factories. These tables also give kinds, quantities, and values of the exports from the various islands for a series of years. They also give the kinds, amounts, values, and sources of the imports for a series of years.

I wish to give credit to Thrums' Annual as the authority from which most of the statistics in the following tables were derived.

LABOR AND WAGES.

The following table gives the comparative wages paid the laborers of the different nationalities. It will be noticed that Portuguese laborers receive considerably higher compensation than either the Japanese or Chinese. None of these Portuguese are contract laborers. It was due to this higher wage of the Portuguese that the customary wages of the laborers has been mentioned in several places as $18 a month, a sum considerably higher than the average paid to Chinese or Japanese.

This table gives the wage scale paid by Ewa Plantation last year. This is one of the largest concerns on the islands, and is situated near Honolulu. All the British, German, American, and Norwegian skilled laborers are excluded from this table. All the laborers receive free lodging, free fuel, and free medical attendance. These wages are probably a shade higher than the average, as I observed that contract men as a rule did not get over $15 per month with the perquisites mentioned:

Classes of laborers and wages paid on Ewa Plantation.

Classes of laborers.	Number employed.	Wages per month.	Total wages paid monthly.
Portuguese	34	$27.55	$930.70
Contract Chinamen	204	15.16	3,092.64
Day Chinamen	67	16.73	1,120.91
Contract Japanese	380	15.66	5,950.66
Day Japanese	100	18.04	1,804.00
Total	785	.....	12,899.00

The following table gives the number and nationality of the plantation laborers on each of the islands separately for the year 1898:

Number and nationality of sugar plantation laborers.[1]

Islands.	Hawaiian.	Portuguese.	Japanese.	Chinese.	South Sea Islanders.	All others.	Total.
Hawaii	516	875	6,338	2,542	20	336	10,627
Maui	457	468	3,117	1,300	27	198	5,567
Molokai	49	4	308	.....	.....	12	373
Oahu	274	245	3,016	1,727	3	220	5,458
Kauai	213	472	4,007	1,631	18	213	6,554
Total:							
1898	1,482	2,064	16,786	7,200	68	979	28,579
1897	1,497	2,218	12,068	8,114	81	675	24,653
Increase	.....	.....	4,718	.....	.....	304	3,926
Decrease	15	154	.....	914	13	.....	.....

[1] Summarized from Report of Bureau of Immigration, December 31, 1898.

The following table gives the number, nationality, and class of the laborers on each of the plantations, together with the totals for each, and other comparative data:

Sugar plantation laborers, October 31, 1899, by plantations.

Name of plantation.	Hawaiian.			Portuguese.				Japanese.			Chinese.			
	Men, contract.	Men, day labor.	Women, day labor.	Men, contract.	Men, day labor.	Women, day labor.	Minors, day labor.	Men, contract.	Men, day labor.	Women, day labor.	Men, contract.	Men, day labor.	Other nationalities.	Total.
OAHU.														
Ewa Plantation	....	.....	....	17	8	....	8	749	228	25	230	174	8	1,447
Waianae Co	....	27	....	....	17	.....	.....	68	64	.....	160	128	13	477
Waialua Plantation	....	21	....	8	109	....	10	549	275	84	.....	303	1	1,360
Kahuku Plantation	....	23	....	....	8	2	1	160	181	35	23	140	13	586
Laie Plantation	....	56	28	....	1	.....	.....	.....	35	3	.....	6	....	129
Heeia Agricultural Co	....	7	...	....	2	....	....	90	176	25	.....	30	....	330
Waimanalo Sugar Co	....	6	....	....	1	.....	.....	.....	130	4	.....	48	....	189
Oahu Sugar Co	....	15	....	4	28	....	9	784	135	86	195	39	30	1,325
Honolulu Sugar Co	....	34	....	8	78	....	....	770	108	118	.....	68	66	1,250
MAUI.														
Olowalu Sugar Co	1	6	....	3	.....	2	....	125	4	20	.....	3	3	167
Pioneer Mill Co	8	40	....	...	5	....	....	941	145	100	210	37	55	1,541
Wailuku Sugar Co	46	65	....	....	85	5	7	225	101	18	37	42	4	635
Hawaiian Commercial and Sugar Co	....	36	...	24	52	....	....	1,114	142	123	241	270	50	2,052
Paia Plantation	....	18	....	11	87	19	1	257	79	48	37	50	36	643
Haiku Sugar Co	....	29	....	9	92	18	11	223	32	24	57	71	32	598
Hana Plantation	....	13	....	....	10	2	3	317	39	36	42	53	11	526
Hamoa Plantation	....	15	....	....	8	....	3	217	6	20	77	.....	4	350
Kipahulu Sugar Co	....	11	9	....	8	7	42	255	12	62	.....	.....	6	412
Kihei Plantation Co	....	56	....	....	5	....	....	398	26	120	.....	80	1	686
Nahiku Sugar Co	....	6	....	....	4	....	....	50	22	4	.....	66	....	152
MOLOKAI.														
American Sugar Co	....	21	....	....	17	....	....	476	18	.....	.....	.....	27	559
Kamalo Sugar Co	....	9	....	....	4	....	....	107	60	37	.....	2	....	219
LANAI.														
Maunalei Sugar Co	....	7	....	....	6	....	....	234	59	46	.....	37	5	394
Palawai Development Association	....	.....	....	....	.....	....	....	.....	9	.....	.....	6	....	15

Sugar plantation laborers, October 31, 1899, by plantations—Continued.

Name of plantation.	Hawaiian.			Portuguese.				Japanese.			Chinese.			
	Men, contract.	Men, day labor.	Women, day labor.	Men, contract.	Men, day labor.	Women, day labor.	Minors, day labor.	Men, contract.	Men, day labor.	Women, day labor.	Men, contract.	Men, day labor.	Other nationalities.	Total.
HAWAII.														
Paauhua Plantation		3			10			358	37	30	48	2	8	496
Hamakua Mill Co		10			46			253	51		46	51	22	479
Kukaiau Plantation Co		5			9			216	47	57	20	28	10	392
Kukaiau Mill Co		1			5				28			5	2	41
Ookala Sugar Co		4	1		20			240	21	22		4	10	322
Laupahoehoe Sugar Co	1	2		11	14			300	56	42	158			584
Hakalau Plantation Co		20			37	12	3	312	244	60	44	49	16	797
Honomu Sugar Co				6	24			276	125	30	68		18	547
Pepeekeo Sugar Co		23		7	15	4	3	365	153	48	66	51	4	739
Onomea Sugar Co		36			147		12	406	295	71	110		21	1,098
Hilo Sugar Co				12	65	9	20	381	156	63	117	21		844
Waiakea Mill Co		2		6	22	2	2	498	159	66	51		19	827
Hawaiian Agricultural Co	2	15		2	34			173	93	19	50	19	26	433
Hutchinson Sugar Plantation	16	74		1	29		10	227	102	16	114	145	33	767
Hawi Mill	24	23		7	13		3	157	37	32		1	2	299
Beecroft Plantation	7	11						18	5	7			7	55
Union Mill Co	33	21			12		1	94	44	30	3	78		316
Kohala Sugar Co	12	18		4	45			192	37	31	26	69		434
Halawa Plantation	11	7			29			68	36	10	13		5	179
Niulii Mill		64			1			62	77	14		15		233
Pacific Sugar Mill		7			14			285	16	35	52	9	2	420
Honokaa Sugar Co		17			25		12	504	30	132	45	15	27	807
Kona Sugar Co					5			6				56	10	77
Hilo Portuguese Sugar Mill Co					4		12		30	3		50		99
Olaa Sugar Co		44			54			884	118	39		111	105	1,355
KAUAI.														
Kilauea Sugar Co		14			53	9	11	288	193	37	19	73	5	702
Makee Sugar Co		28			61	18	18	471	346	40	110	51	25	1,168
Lihue & Hanamaulu Mill		27			88	16	25	593	298	57	36	164	55	1,359
Koloa Sugar Co	2	3		3	4		3	595	31	74	114	9	13	851
Hawaiian Sugar Co		5		10	37	2	9	414	242	69	79	200	42	1,109
Gay and Robinson		12			23		7		90			18		150
Waimea Sugar Mill					7		4	64	27	11		12		125
Kekaha Sugar Co		7			7		2	300	149	68	70	85	17	705
Grove Farm		35							115	18		92	1	261
McBryde Sugar Co		66			24	3		438	167	97		65	15	875
Totals:														
1899	163	1,125	38	153	1,618	130	252	17,547	5,741	2,366	2,768	3,201	806	35,987
1898	231	1,214	37	36	1,683	124	221	10,527	5,208	1,051	4,877	2,323	979	28,579
1897	334	1,128	35	384	1,448	108	314	6,329	4,999	749	6,398	1,716	675	24.653

The following table contains statistics of the skilled labor employed by the plantation companies:

Number and nationality of all skilled laborers on Hawaiian sugar plantations October 31, 1899, by occupations.

	Americans.	Hawaiians.	British.	Germans.	Portuguese.	Scandinavians.	Austrians.	Japanese.	Chinese.	Other nationalities.	Total.
Overseers	197	114	125	123	188	36	6	93	34	10	926
Engineers and firemen	73	19	47	32	40	14	5	35	16		281
Bookkeepers and clerks	43	9	31	11	5	3		7	4	1	114
Sugar boilers	10	8	12	23	3		1	5	6	2	70
Carpenters	55	45	10	10	39	14	1	225	31	2	432
Blacksmiths	10	15	13	8	14	2	2	42	2	4	112
Masons	5	3	9	2	12			7			38
Painters	2	4	2	1	4	1		2	1	2	19
Harness makers	1		1	2		1				1	6
Chemists	9	2	2	6			1			1	21
	405	219	252	218	305	71	16	416	94	23	2,019

EXPORTS AND IMPORTS.

The table following shows the quantities and values of all the articles exported from the islands. It will be seen that sugar constitutes in value more than 99 per cent of the total exports:

Quantities and values of Hawaiian exports of all kinds to all countries for 1898.

Articles.	United States.		Australia and New Zealand.		China and Japan.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Sugar ..... pounds..	444,961,611	$16,614,430.53	1,425	$192.00	.....	.....
Rice ..... do....	2,865,500	149,268.64	.....	.....	.....	.....
Coffee ..... do....	659,947	102,938.11	38,494	7,249.62	8,065	$1,265.00
Bananas ..... bunches..	79,482	65,418.61	.....	.....	.....	.....
Wool ..... pounds..	3,731	265.00	.....	.....	.....	.....
Hides ..... number..	31,230	114,646.82	.....	.....	50	300.00
Pineapples ..... do....	48,910	6,337.53	24	2.40	.....	.....
Goat and deer skins ..... do....	9,087	4,264.65	4	20.00	.....	.....
Sheep skins ..... do....	7,519	2,357.91	.....	.....	.....	.....
Tallow ..... pounds..	220,707	7,949.10	.....	.....	.....	.....
Molasses ..... gallons..	4,537	919.18	.....	.....	.....	.....
Betel leaves ..... boxes..	120	512.00	.....	.....	.....	.....
Taro flour ..... sacks..	35	23.00	.....	.....	.....	.....
Plants, seeds ..... pieces..	962	2,909.40	6	12.00	.....	.....
Sundry fruits ..... packages..	748	450.65	.....	.....	.....	.....
Awa ..... pounds..	5,376	409.47	.....	.....	.....	.....
Bones and horns .... packages..	33,971	2,352.60	.....	.....	.....	.....
Curios ..... do....	7	111.00	19	725.00	2	35.00
Canned pineapples ..... cans..	3,077	5,580.85	.....	.....	.....	.....
Honey ..... do....	11	65.00	692	3,058.25	70	190.00
Specie	.....	100,000.00	.....	4,800.00	.....	33,620.00
Hide trimmings ..... pounds..	3,030	39.60	.....	.....	.....	.....
Sundries ..... packages..	53	1,427.60	34	755.00	40	168.25
Foreign	.....	73,407.24	.....	5,059.50	.....	9,245.25
Total	.....	17,256,084.49	.....	21,873.77	.....	44,823.25
Per cent of total	.....	99.44	.....	.13	.....	.28

Articles.	Canada.		Total.	
	Quantity.	Value.	Quantity.	Value.
Sugar ..... pounds..	.....	.....	444,963,036	$16,614,622.53
Rice ..... do....	200	$9.50	2,865,700	149,278.14
Coffee ..... do....	26,779	4,492.16	733,285	115,944.89
Bananas ..... bunches..	1,161	1,162.30	80,643	66,580.91
Wool ..... pounds..	.....	.....	3,731	265.00
Hides ..... number..	.....	.....	31,280	114,946.82
Pineapples ..... do....	14,793	2,331.72	63,727	8,669.25
Goat and deer skins ..... do....	.....	.....	9,091	4,284.65
Sheepskins ..... do....	.....	.....	7,519	2,357.91
Tallow ..... pounds..	.....	.....	220,707	7,949.10
Molasses ..... gallons..	.....	.....	14,537	919.18
Betel leaves ..... boxes..	.....	.....	120	512.00
Taro flour ..... sacks..	.....	.....	35	23.00
Plants, seeds ..... pieces..	.....	.....	968	2,921.40
Sundry fruit ..... packages..	12	22.00	760	472.65
Awa ..... pounds..	.....	.....	5,376	409.47
Bones and horns ..... packages..	.....	.....	33,971	2,352.60
Curios ..... do....	.....	.....	28	871.00
Canned pineapples ..... cans..	74	235.50	3,151	5,816.35
Honey ..... do....	.....	.....	773	3,313.35
Specie	.....	.....	.....	138,420.00
Hide trimmings ..... pounds..	.....	.....	3,030	39.60
Sundries ..... packages..	46	642.00	173	2,992.85
Foreign	.....	15,070.50	.....	102,782.24
Total	.....	23,963.28	.....	17,346,744.79
Per cent of total	.....	.15	.....	100.00

In the table which follows is given a list of the articles imported into the Hawaiian Islands, together with the classification and total value of each:

Value of Hawaiian imports, 1898.[1]

Articles.	Value, goods paying duty.	Value, goods free by treaty.	Value, goods free by civil code.	Total value.
Ale, porter, beer, cider	$118,296.96		$23.00	$118,319.96
Animals and birds	384.73	$123,007.19	1,907.32	125,299.24
Building materials	165,856.91	147,255.90	5,222.34	318,325.15
Clothing, hats, boots	211,868.95	260,715.11	2,529.10	475,113.16
Coal and coke		8,184.15	600,534.17	608,718.32
Crockery, glassware, lamps, etc	68,717.70		880.31	69,598.01
Drugs, surgical instruments, and dental materials	89,195.73		550.00	89,745.73
Dry goods:				
Cottons	155,834.44	291,638.08		447,472.52
Linens	50,683.45			50,683.45
Silks	48,127.83		75.00	48,202.83
Woolens	136,665.91	10,472.22	891.68	148,029.81
Mixtures	29,768.43	736.15		30,504.58
Fancy goods, millinery, etc	130,768.79	16,005.69	633.38	147,407.86
Fertilizer, bone meal, etc			308,415.21	308,415.21
Fish (dried and salt)	33,034.15	63,636.08		96,670.23
Flour	10,684.10	262,696.94		273,381.04
Fruits (fresh)	1,389.71	20,827.03		22,216.74
Grain and feed	204.90	441,343.29	382.50	441,930.69
Groceries and provisions	284,935.33	491,221.16	666.20	776,822.69
Guns, gun material, and gunpowder	22,922.65	3,170.92	1,440.40	27,533.97
Hardware, agricultural implements, and tools	101,226.28	372,531.39	17,802.07	491,559.74
House furnishings	70,343.48	84,637.62	1,360.15	156,341.25
Iron, steel, etc	15,567.48	63,234.19	23,343.00	102,144.67
Jewelry, plate, clocks	33,573.30		1,352.50	34,925.80
Leather	2,040.24	36,752.25		38,792.49
Lumber	277.63	356,243.39	8.35	356,529.37
Machinery	188,107.66	634,144.16	36,877.91	859,129.73
Matches	1,754.77	21,069.66		22,824.43
Musical instruments	5,387.13	22,976.01	4,017.70	32,380.84
Naval stores	8,997.44	54,724.80	10,539.07	74,261.31
Oils (cocoanut, kerosene, whale, etc)	43,100.57	84,477.89	549.47	128,127.93
Paints, paint oil, and turpentine	48,373.79	3,434.78		51,808.57
Perfumery and toilet articles	18,313.32	9,257.34		27,570.66
Railroad materials, rails, cars, etc	43,914.70	137,757.67		181,672.37
Saddlery, carriages, and materials	83,856.95	58,023.51	2,547.96	144,428.42
Sheathing metal		78.00	4,543.26	4,621.26
Shooks, bags, and containers	256,848.68	14,131.85	22,218.02	293,198.55
Spirits	76,708.75		171.98	76,880.73
Stationery and books	17,947.93	85,710.94	10,369.84	114,028.71
Tea	53,160.05			53,160.05
Tin, tinware, and materials	15,409.89		639.81	16,049.70
Tobacco, cigars, etc	83,647.57	179,788.71	39.96	263,476.24
Wines (light)	31,569.39		90,728.00	122,297.39
Sundry personal and household effects	6,123.41		51,662.77	57,786.18
Sundry merchandise not included in the above	182,846.30	100,402.83	22,101.23	305,350.36
Charges on invoices	90,804.83	33,311.19	3,731.24	127,847.26
25 per cent added on uncertified invoices	2,128.58			2,128.58
	3,041,360.79	4,493,598.09	1,228,754.90	8,763,713.78
Discounts	14,754.71	7,300.89	69.48	22,124.08
Total at Honolulu	3,026,607.08	4,486,297.20	1,228,685.42	8,741,589.70
Total at all other ports	110,969.18	1,233,873.72	282,382.49	1,627,225.39
Total at Honolulu	3,026,607.08	4,486,297.20	1,228,685.42	8,741,589.70
Total at Hilo	54,522.85	559,982.38	172,597.82	787,103.05
Total at Kahului	47,303.49	521,284.68	79,258.39	649,846.56
Total at Mahukona	9,142.84	142,533.78	30,502.28	182,178.90
Total at Kailua		10,072.88	24.00	10,096.88
Total Hawaiian Islands	3,137,576.26	5,720,170.92	1,511,067.91	10,368,815.09
Specie			1,282,075.72	
Total, including specie				11,650,890.81

[1] From custom-house tables.

This table shows the class and value of goods imported into the Hawaiian Islands, together with countries supplying the same; also the nationality of the vessels carrying the imported goods:

Sources and values of Hawaiian imports for 1898.

Countries from which imported.	Goods paying duty.	Spirits paying duty.	Spirits bonded.	Goods free by treaty.	Goods free by civil code.	Per cent.	Total, 1898.
United States	$741,910.71	$95,902.99	$44,024.45	$5,720,170.92	$2,000,733.86	74.64	$8,695,591.63
Great Britain	1,104,419.43	4,615.31	14,523.07	.....	162,178.95	11.05	1,287,726.67
Germany	307,920.77	6,269.73	4,031.77	.....	30,104.50	3.02	352,043.65
China	304,700.59	486.60	15,236.44	.....	224.00	2.82	328,851.87
Japan	284,629.10	25,044.64	1,855.86	.....	42,687.00	3.04	354,324.98
Australia and New Zealand	22,928.91	161.31	530.23	.....	170,888.73	1.70	198,384.61
Canada	14,490.88	.....	2,766.05	.....	266,108.42	2.43	283,383.40
Islands of the Pacific	271.53	.....	.....	.....	7,020.59	.06	7,292.12
France	15,763.68	849.12	5,905.62	.....	6,155.47	.38	43,655.55
Other countries	50,115.62	233.23	9,562.61	.....	3,115.96	.86	99,636.33
Total	2,847,151.32	133,562.93	98,436.10	5,720,170.92	2,689,217.48	100.00	11,650,890.81

Nationality of vessels carrying Hawaiian imports for 1898.

Nationality.	Per cent.	Total, 1898.
American	60.32	$7,028,026.36
British	21.17	2,466,116.08
German	4.60	535,975.59
Hawaiian	13.29	1,548,352.23
All others	.62	72,420.55
Total	100.00	11,650,890.81

The following table of total imports of the islands for the first nine months of 1899, with the comparative figures for the like three quarters of the previous year, shows increase of business and commercial activity:

Value of imports for first nine months of 1899 and 1898.

Classification.	Import values.	
	1899.	1898.
Goods free by treaty	$6,791,571.19	$3,959,413.30
Goods free by civil code	4,081,930.34	1,500,998.08
Goods and spirits paying duty	2,659,590.74	1,796,625.77
Goods and spirits bonded	134,280.33	103,541.41
Total	13,667,372.60	7,360,580.56

The value of imports for October gave $1,387,044.71 additional, a falling off as compared with same month's imports in 1898, but showing a total gain over the ten months of last year of $6,094,488.81.

Exports for the nine months ending September 30 from all ports show a total value of $21,149,176.82, as against $15,840,373.69, for the like period of last year, a gain of $5,308,803.13.

POPULATION.

The following table shows the numbers and nationalities of the population of the islands as estimated at the close of the fiscal year 1899:

Estimated population Hawaiian Islands June 30, 1899.[1]

	Natives.	Chinese.	Japanese.	Portuguese.	All other foreigners.	Total.
Population as per census, Sept., 1896	39,504	21,616	24,407	15,191	8,302	109,020
Excess of arrivals over departures, 4th quarter, 1896	.....	1,377	1,673	.....	339	3,389
Excess of arrivals over departures, Jan., 1897, to June, 1899	.....	4,204	16,296	37	2,007	22,544
Total	39,504	27,197	42,376	15,228	10,648	134,953

[1] Changes resulting from births and deaths since the census of 1896 are disregarded, owing to incomplete records.

The following table shows the annual death rate in the islands for 1896, 1897, and 1898:

Annual death rate per 1,000 in the Hawaiian Islands.

	1896.	1897.	1898.	Estimated population, Honolulu.
All nationalities	22.43	21.97	29.73	30,000
Hawaiians	32.78	29.30	40.06	11,500
Asiatics	14.60	19.30	24.42	9,000
Portuguese	19.48	15.79	22.02	2,000
All others	16.10	14.68		7,500

SUMMARY OF PLANTATION STATISTICS.

In the following table are given the amounts and values of the sugar and molasses produced in the islands, and the value of that portion exported for the years 1875–1899 inclusive:

Amounts, values, and exports of Hawaiian sugar and molasses, 1875–1899.[1]

Year.	Sugar.		Molasses.		Total export value.
	Pounds.	Value.	Gallons.	Value.	
1875	25,080,182	$1,216,388.82	93,722	$12,183.86	$1,228,572.68
1876	26,072,429	1,272,334.53	130,073	19,510.95	1,291,845.48
1877	25,575,965	1,777,529.57	151,462	22,719.30	1,800,248.87
1878	38,431,458	2,701,731.50	93,136	12,107.68	2,713,839.18
1879	49,020,972	3,109,563.66	87,475	9,622.52	3,119,185.91
1880	63,584,871	4,322,711.48	198,355	29,753.52	4,352,464.73
1881	93,789,483	5,395,399.54	263,587	31,630.44	5,427,020.98
1882	114,177,938	6,320,890.65	221,293	33,193.95	6,354,084.60
1883	114,107,155	7,112,981.12	193,997	34,819.46	7,147,800.58
1884	142,654,923	7,328,896.67	110,530	16,579.50	7,345,476.17
1885	171,350,314	8,356,061.94	57,941	7,050.00	8,363,111.94
1886	216,223,615	9,775,132.12	113,137	14,501.76	9,789,633.88
1887	212,763,647	8,694,964.07	71,222	10,522.76	8,705,486.83
1888	235,888,346	10,818,883.09	47,965	5,900.40	10,824,783.49
1889	242,165,835	13,089,302.10	54,612	6,185.10	13,095,487.20
1890	259,789,462	12,159,585.01	74,926	7,603.29	12,167,188.30
1891	274,983,580	9,550,537.80	55,845	4,721.40	6,555,258.20
1892	263,636,715	7,276,549.24	47,988	5,061.07	7,281,610.34
1893	330,822,879	10,200,958.37	67,282	5,928.96	10,206,887.33
1894	306,684,993	8,473,009.10	72,979	6,050.11	8,479,059.21
1895	294,784,819	7,975,590.41	44,970	3,037.83	7,978,628.24
1896	443,569,282	14,932,172.82	15,885	1,209.72	14,933,382.54
1897	520,158,232	15,390,422.13	33,770	2,892.72	15,393,314.85
1898	444,963,036	16,614,622.53	14,537	919.18	16,615,541.71
1899[2]	387,599,795	15,154,826.41	.....	.....	15,154,826.41

[1] Calendar years.

[2] Six months to June 30.

In the following table is given a list of all the plantation companies, together with data concerning the organization, status, and work of each:

List of incorporated Hawaiian sugar plantations October 10, 1899.

Island and name of plantation.	Honolulu agents.	Total capital.	Paid-up stock.	Par value of shares.	Market price of paid-up stock.	Tons of sugar crop of 1898.
OAHU.						
Ewa Plantation Co	Castle & Cooke	$5,000,000	$5,000,000	$20	$28	19,580
Waianae Co	J. M. Dowsett	300,000	300,000	100	175	4,055
Waialua Plantation Co	Castle & Cooke	3,500,000	1,500,000	100	160	.....
Kahuku Plantation Co	M. S. Grinbaum & Co	500,000	500,000	100	160	4,356
Heeia Agricultural Co	do	150,000	150,000	100	.....	2,167
Waimanalo Sugar Co	W. G. Irwin & Co	252,000	252,000	100	150	3,004
Oahu Sugar Co	H. Hackfeld & Co	3,600,000	3,000,000	100	190	.....
Honolulu Sugar Co	W. G. Irwin & Co	900,000	.....	100	.....	.....
MAUI.						
Olowalu Sugar Co	W. G. Irwin & Co	150,000	150,000	100	150	.....
Pioneer Mill Co	H. Hackfeld & Co	2,000,000	2,000,000	100	240	5,560
Wailuku Sugar Co	C. Brewer & Co	700,000	700,000	100	400	6,691
Hawaiian Commercial and Sugar Co.	Alexander & Baldwin	10,000,000	2,312,750	100	100	15,000
Paia Plantation	do	750,000	750,000	100	300	5,511
Haiku Sugar Co	do	500,000	500,000	100	275	4,709
Hana Plantation	M. S. Grinbaum & Co	1,000,000	.....	20	.....	2,041
Hamoa Plantation	C. Brewer & Co	175,000	175,000	100	.....	.....
Kipahulu Sugar Co	H. Hackfeld & Co	160,000	160,000	100	115	1,987
Kihei Plantation	Alexander & Baldwin	3,000,000	1,500,000	50	.....	.....
Nahiku Sugar Co	do	750,000	.....	.....	.....	.....
MOLOKAI.						
American Sugar Co	C. Brewer & Co	1,500,000	750,000	100	.....	.....
Kamalo Sugar Co	F. Hustace	1,000,000	250,000	100	.....	.....
LANAI.						
Maunalei	Gear, Lansing Co	1,000,000	100,000	20	.....	.....
HAWAII.						
Paauhau Plantation	W. G. Irwin & Co	5,000,000	5,000,000	50	.....	.....
Hamakua Mill Co	T. H. Davies & Co	500,000	500,000	100	.....	3,961
Kukaiau Plantation	H. Hackfeld & Co	120,000	120,000	100	.....	.....
Ookala Sugar Co	C. Brewer & Co	500,000	500,000	20	.....	.....
Laupahoehoe Sugar Co	T. H. Davies & Co	300,000	250,000	50	.....	3,970
Hakalau Plantation	W. G. Irwin & Co	1,000,000	1,000,000	100	.....	9,090
Honomu Sugar Co	C. Brewer & Co	750,000	750,000	100	170	4,950
Pepeekeo Sugar Co	T. H. Davies & Co	750,000	750,000	100	200	6,916
Onomea Sugar Co	Castle & Cooke	1,000,000	1,000,000	20	38	8,900
Hilo Sugar Co	W. G. Irwin & Co	500,000	500,000	100	.....	8,409
Waiakea Mill Co	T. H. Davies & Co	600,000	600,000	100	.....	7,763
Hawaiian Agricultural Co	C. Brewer & Co	1,000,000	1,000,000	100	315	7,548
Hutchinson Sugar-Plant Co	W. G. Irwin & Co	2,500,000	.....	50	.....	7,189
Union Mill Co	T. H. Davies & Co	200,000	200,000	100	.....	1,085
Kohala Sugar Co	Castle & Cooke	480,000	480,000	500	.....	1,508
Pacific Sugar Mill	F. A. Schaefer & Co	500,000	500,000	100	300	3,326
Honokaa Sugar Co	do	2,000,000	2,000,000	20	35	6,198
Kona Sugar Co	McChesney & Sons	500,000	180,000	100	.....	.....
Olaa Sugar Co	Alexander & Baldwin	5,000,000	2,500,000	20	.....	.....
KAUAI.						
Kilauea Sugar Co	W. G. Irwin & Co	300,000	300,000	1,000	.....	3,835
Makee Sugar Co	C. Brewer & Co	500,000	.....	.....	.....	.....
Lihue Plantation Co	H. Hackfeld & Co	1,400,000	1,400,000	100	.....	10,914
Koloa Sugar Co	do	300,000	300,000	100	200	4,327
McBryde Sugar Co	T. H. Davies & Co	3,500,000	1,650,000	20	.....	.....
Hawaiian Sugar Co	Alexander & Baldwin	2,000,000	2,000,000	100	225	11,913
Waimea Sugar Mill	Castle & Cooke	125,000	125,000	100	.....	900
Kekaha Sugar Co., Ltd	H. Hackfeld & Co	600,000	600,000	.....	.....	2,460

NOTE.—Total incorporated plantation capital as shown above is $68,812,000, all of which has been sold and issued. Of this amount about seven and a quarter millions are not yet due and paid in on the assessable stocks.

Market prices quoted are approximate for October 10, 1899. Many stock issues are held by capitalists who do not offer them on the market. Although most of them are worth a considerable premium, no price can be quoted.

Plantations of private individuals are not included in the above list.

REPORT OF THE CHEMIST,

H. W. WILEY.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., April 13, 1900.

SIR: I beg to transmit herewith the manuscript of my report on the distribution of beet seed during the season of 1899, with some general observations on the sugar-beet industry in the United States, followed by the results of the analyses of the samples of sugar beets received by this laboratory and a discussion of the data obtained.

Respectfully,

H. W. WILEY,
Chief of the Division of Chemistry.

HON. JAMES WILSON,
Secretary of Agriculture.

DISTRIBUTION OF SUGAR-BEET SEED FOR CULTURAL EXPERIMENTS, 1899.

In order to bring the work of the Department more in harmony with the principles of its organization, arrangements were made with the chief of the Division of Botany, with the approval of the Secretary of Agriculture, to distribute hereafter all the beet seed used by the Department. The work of the Division of Chemistry is in no way connected with the purchase and distribution of valuable seeds, and it seems altogether appropriate that this work should be intrusted exclusively to the Division of Botany, whose section of seed and plant introduction was organized for the purpose. All information in regard to the character of the sugar-beet seed required, where to purchase, and the localities where the best results could be obtained was reported to the section of seed and plant introduction.

The seed was distributed to a number of the agricultural experiment stations, and in general to farmers living in regions where the prospects of securing good results were sure. The distribution was made as shown by the following data, taken from the Annual Report of the Department of Agriculture for the fiscal year ended June 30, 1899 (pp. 6 and 7), being the report of the Assistant Secretary of Agriculture upon the purchase and distribution of seeds:

The following statement of the purchase and distribution of sugar-beet seed during the past season is furnished by the chemist of the Department, Dr. H. W. Wiley,

by whom this seed was purchased, mainly from the fund for the investigation of the domestic sugar production. The distribution was directed by the chemist, but was actually carried out through the section of seed and plant introduction of the Division of Botany.

The amounts and cost of sugar-beet seed purchased and distributed in 1898 are as follows:

Five metric tons "Zehringen" beet seed from Adolph Strandes, Zehringen, Germany, at $160 per ton	$800.00
Freight from New York to Washington, D. C	34.65
Consular invoice	2.50
Three metric tons Knauer's "Mangold Elite" beet seed, through H. Cordes, Lagrande, Oreg	501.00
Freight from New York	31.20
Five metric tons Dippe's "Kleinwanzlebener Elite" beet seed, through August Rölker & Sons, 52 Dey street, New York, agents, at $195 per ton (freight prepaid)	975.00
Five metric tons "White Improved Vilmorin" beet seed, through Willett & Gray, 91 Wall street, New York, agents, at $176.40 per ton (freight prepaid)	882.00
Total	3,226.35

The weight of seed purchased and donated by varieties was as follows:

	Pounds.
White Improved Vilmorin	11,025
Knauer's Mangold Elite	6,615
Dippe's Kleinwanzlebener Elite	11,025
Strandes Zehringen	11,025
Total purchased	39,690
Biendorf Elite Kleinwanzlebener	2,420
Total weight of seed distributed	42,110

The Biendorf seed was grown by Carl Braune, Biendorf, Germany, and was presented to the Department by Hoff Brothers, Chicago.

Nearly one-half of this seed was distributed among twenty-nine of the State experiment stations and the remainder to individuals and associations, either at the request of members of Congress or on direct application.

The beet-sugar industry is already so well established in California that but few applications for seed were received from that State. The largest quantities of seed were sent to the States of Colorado, Illinois, Indiana, Iowa, New York, North Carolina, North Dakota, Ohio, Pennsylvania, West Virginia, and Wisconsin. Apparently the best results from the experiments are obtained through the distribution of the seed by the stations and by the associations formed for the purpose. In general, the seed sent to individuals on direct application to the Department does not yield very satisfactory results. This is due to lack of competent supervision of the experiments.

General Observations on the Sugar-Beet Industry.

SUGAR-BEET GROWING IN CALIFORNIA.

During the summer of 1899 the writer visited many of the localities in California devoted to the growth of sugar beets. The conditions of this growth in California are somewhat unique. As a rule, no rainfall is expected during the growing season, or at least not after the early part thereof. The beets are chiefly grown also without irrigation. The moisture which the beets receive is derived from the heavy fogs which come in from the sea and from the lower depths of the soil.

The coast valleys, where the sugar beets grow to the greatest perfection, evidently receive a considerable quantity of moisture from the surrounding mountains and hills by subterranean passages. It thus

happens if the beets can secure a good start by the moisture coming as rainfall they will be supplied with a sufficient quantity of moisture by the agency of these subterranean passages to complete their growth.

The year 1899, as well as the preceding one, in California was a year of unusually small rainfall. For this reason the sugar beets at the start did not have a sufficient quantity of moisture to produce a good growth. As a result the beet crop throughout the State was not up to the normal. Many fields were observed which were total failures, while in others only parts of the field had produced an average crop. The beets were usually rather small in size but were rich in sugar, of which they gave a good yield.

It is evident that if the area devoted to sugar beets in California is to be very much extended irrigation must be practiced; otherwise, the excessively dry seasons, which occur at irregular intervals, will produce disastrous results from an agricultural point of view upon the beet crops. Steps have already been taken by some of the more extensive growers in the State to secure the irrigation necessary to insure a crop every season. At the new sugar factory at Betteravia, in Santa Maria, the writer saw last August the arrangements which had been perfected for pumping water from the lake to the highest points of the beet fields to be distributed over the ground. At Chino many of the fields have been leveled, preparatory to placing them under irrigation. Thus, a very considerable area of beet lands will be artificially watered.

There are very few localities in California where the natural supply of moisture is sufficient to insure a crop every year. There is probably no other agricultural crop grown at present in the State which will so well repay the great cost of irrigation as the sugar beet. A good crop of sugar beets will pay the interest on $300, which probably would be the average cost of well irrigated land of the highest fertility.

SUGAR-BEET GROWING IN THE STATE OF MICHIGAN.

There is no State in the Union where so great progress has been made during the past year in the growing of sugar beets as in Michigan. A large number of new factories have been completed.

As is to be expected in new enterprises of this kind, many failures occurred among persons engaged in the growing of beets who were not skilled in that branch of agriculture. Some of these failures were attributed to seasonal influences, but many of them were doubtless due to imperfect cultivation. Where the best system of agriculture is employed in the growing of beets, as has been seen in the case of California, the beet grower is reasonably independent of the ordinary seasonal variations. A summer with unusual rainfall or one with a deficient supply will not materially affect the yield, if all the modern principles of beet growing are understood and applied. Under the circumstances, it is not surprising that many of the beets produced in Michigan were of abnormal character by reason of the seasonal influences or imperfect cultivation.

Some dissatisfaction arose between the farmers and the owners of the factories in Michigan in regard to the methods of analysis employed. By authority of the Secretary of Agriculture, the assistant chief of the Division of Chemistry, Mr. E. E. Ewell, visited the State and made as thorough an investigation of the conditions as was possible in the short time at his disposal. The following is his report on the methods employed for determining the deduction to be made for tare, for the analysis of the beets, etc., at one of the factories, which may be regarded as in a large measure typical of the system in vogue at the other factories of the State:

Handling and Analysis of Beets at the Receiving Laboratory of a Michigan Beet-Sugar Factory.

I was forcibly impressed with the great pains that the officials of the factory visited were taking to secure an accurate and equitable determination of the quantity and quality of each load of beets delivered, and also with the faithfulness with which the employés to whom this work was intrusted were performing their respective duties. In fact, I was at a loss to account for the uniformly high efficiency of the laborers in the tare room until I was told that they were selected from a lot of fifty or more men who had been tested in regard to their ability to perform the various kinds of work in a satisfactory manner. The sampling, taring, preparing for analysis, and analyzing of several hundreds of samples of beets daily is indeed a gigantic task, and one that can not be performed with economy and with a degree of accuracy appropriate for even commercial work without a carefully thought-out system and ample facilities.

The grading of the purchase price of beets according to their quality is certainly a great advantage to factory owners and to the careful farmers who grow the beets. The first step in this direction was the fixing of the price according to the density of the juice of the beet as determined with a hydrometer, a method that was extensively used in Europe until recently, and is possibly in use to some extent there at the present time. The determination of the percentage of sugar in each load of beets by the polariscopic test, now practiced at the Michigan factories, is a decided advance.

The system and equipment for this work seem to have been remarkably well planned considering the difficulties and the fact that this is the first season this factory has been in operation. I am able to make very few suggestions in regard to the improvement of the work in the receiving laboratory, all of which are stated below, and which have largely to do with the economical side of the question rather than with the accuracy of the work.

Taking the tare.

From each load of beets passing over the receiving scales to the storage sheds a sample of 20 pounds or more is placed in a basket and sent to the tare room. Each load is given a serial number by the weigher, and a card bearing this number is attached to the handle of the basket containing the sample. In order to determine the percentage of tare to be deducted for the dirt adhering to the beets and for improper topping, 20 pounds are weighed on an appropriate scale. The excess of the sample is discarded, while the weighed portion of 20 pounds is returned to the basket. The exact "gross weight" is entered by the weigher upon the tag attached to the basket, in a blank space provided for the purpose. The sample of beets next passes to the "topper," who cuts off the top of the beet at the bottom leaf scar if the topping has not already been done at that point. The samples are then taken to the "brushers," who thoroughly clean the beets by means of wire brushes. These

brushes occasionally abrade the surface of the beets, but a thorough inspection convinced me that the slight reduction of the weight of the beet in this manner is practicably unavoidable, and is fully compensated for by the small amount of soil still left adhering to the beets in crevices and depressions out of the reach of the brushers. After this thorough brushing the beets are again weighed, and the "clean weight" is recorded upon the tag attached to the handle of the basket. This operation completes the work of determining the percentage of tare, with the exception of the clerical work of making the calculation and recording the results. The percentage deducted for tare varies from 1¼ to 20 (or, in extreme cases, 40 per cent), but is generally between 2½ and 12½.

The only suggestion that occurred to me in regard to this part of the work is the substitution of a metric system dial scale for the scale with sliding weight, reading in pounds and ounces. The dial scale would have the advantage of saving the loss of time incident to adjusting the weight of the sample to approximately 20 pounds, and the additional advantage of simplifying the calculation in case a 10-kilogram (22.05 pounds) sample were used, as in this case every 100 grams of difference in weight between the "gross" and "clean" weights would correspond to 1 per cent of tare. In case of a slight excess of weight above 10 kilograms, a very simple division would give the percentage of tare.

The selection of the beets to adjust the weight of the sample to approximately 20 pounds also has the objection that the weigher is likely to select small beets for this purpose, and thus give beets of small size an undue prominence in the sample. The error involved, though undoubtedly a very small one, would be one constantly in favor of the farmer, as it is well known that small beets, if ripe, are generally richer in sugar than larger ones.

The dial scale would have the objection of being more liable to get out of order without the knowledge of the user than the scale with sliding weights; but a standard 10-kilogram weight could be kept convenient for testing the accuracy of the scale one or more times each day. Moreover, the continued use of this form of weighing apparatus in the retail meat and grocery trade, where rigid inspection is practiced, indicates its reliability.

OBTAINING THE JUICE FOR ANALYSIS.

After the "clean weight" is recorded the sample passes to the workman who quarters the beets. He empties the beets out of the basket upon his worktable, and, after quartering one, places one quarter in the basket and rejects the remaining three quarters. This is continued, picking up the beets "just as they come," without selecting them, until a sufficient number of quarters has been obtained to provide enough juice for the work of the chemist.

The sample is then taken by the workman in charge of the grating machine and reduced to a fine pulp. This machine consists of a wooden cylinder armed with rows of iron teeth, and is similar to the power graters used for horse-radish. It is driven at a rapid rate by means of a gasoline engine. I did not ascertain the exact number of revolutions per minute.

The pulp is received in a galvanized iron pan placed underneath the grater. Both the pan and the cover of the grating machine are freed from adhering pulp after the grating of each sample in as thorough a manner as can be expected in commercial work of this kind.

The pressman takes the pulp from the collecting pan of the grating machine, wraps it in a square of filter press cloth, and expresses the juice by means of a lever press, receiving the juice in a tin cylinder, which is passed through a window to the laboratory along with the tag, which has until this time remained attached to the handle of the sample basket.

The exhausted pulp is removed from the press cloth, and the latter is used over again for the next sample. While this cloth comes from the press reasonably dry, it

is still moist with the juice of the sample just pressed; and the juice contained in the cloth and that adhering to the press contaminates the following sample to an appreciable extent when two successive samples of beets are of widely different degrees of richness. This overlapping of the juice of successive samples at the press is the only point needing reform that I was able to discover in the room where the taring and the extraction of the juice were performed. It gives rise to a slight error at times, which gives a little advantage to the farmer who brings poor beets, and works to the disadvantage of the farmer who brings beets of higher quality. It can be neither a source of loss nor of gain to the factory, as it merely tends to average the price in case two samples of widely different quality follow one another through the press. In the majority of cases, where the difference between the percentage of sugar in two successive samples is less than 1 per cent, there can, of course, be no appreciable error from this source. I shall refer to this subject again in discussing the laboratory methods; but before doing so I wish to suggest a method by which the danger of error from the overlapping of the juice of successive samples at the press can be practically, if not absolutely, eliminated.

(1) A tin quart cup would be a more convenient vessel for receiving the juice as it flows from the press than the cylinders now used. The tag used for identifying the samples and for recording the results of taring and analysis can be attached to the handle of this cup immediately after its removal from the handle of the sample basket.

(2) The sample of pulp taken for pressing should be sufficient to yield from 2 to 3 pints of juice.

(3) The first pint that flows from the press should be discarded and the remaining 1 or 2 pints should be saved. The press cloth and press could then be washed free from the juice of the previous sample by means of this rejected portion of juice.

(4) The excess of pulp and juice obtained by this method of working need not be lost, as it can readily be conveyed to the diffusion battery and thus saved.

It has been found that the juice obtained from the same pulp by light and heavy pressures differs slightly in the percentage of sugar contained therein. The following analytical data, obtained by myself, clearly demonstrate that no such difference is observable with the differences of pressure obtainable with the lever press used in the receiving laboratory of this factory. There is, therefore, no objection on these grounds to the method that I have just suggested for eliminating the error due to the overlapping of the juice at the press.

Results of analyses of beet juice made to determine the influence of the differences of pressure obtainable with a lever press on the comparative richness of the juice obtained by light and heavy pressure.

[The letter A is used to designate samples of juice obtained by light pressure; the letter B is used to designate those obtained by heavy pressure. The same portion of pulp was used, the first portion of juice being designated A and the second portion B.]

Number of sample.	Total solids. *a*	Sugar in the juice. *b*	Coefficient of purity.
	Per cent.	*Per cent.*	
1A	16.48	13.88	84.2
1B	16.31	13.85	84.9
2A	17.07	*c* 14.55	85.2
2B	17.21	14.88	86.5
3A	17.21	14.25	82.8
3B	17.23	14.34	83.2
4A	17.78	14.73	82.8
4B	18.00	*d* 14.77	82.1
5A	17.10	13.99	81.8
5B	17.22	13.94	81.0

a The percentage of total solids in samples Nos. 1 and 2 was determined by weighing the juices in a carefully calibrated 100-cubic-centimeter flask; in the case of samples Nos. 3 to 5, inclusive, this determination was made by means of the Brix hydrometer.

b For the determination of sugar, a quantity of juice (obtained by weighing) equal to double the normal weight for the polariscope, was placed in a 100-cubic-centimeter (Mohr's) flask, treated with

It must be admitted that these results would have been more conclusive if the press had been cleaned and dried between samples and a fresh press cloth taken for each sample. I believe, however, that they may be accepted as abundant evidence that there is practically no variation in the percentage, of sugar in the juices obtained by pressures varying within the limits obtainable with the form of press used in the receiving laboratory of this company. It is certainly quite negligible in comparison with the error that may now be caused at times by the overlapping of the juices of successive samples.

THE CHEMICAL ANALYSIS OF THE JUICE.

Earlier in the campaign this company had undertaken to make direct determinations of the percentage of sugar in the beets, samples of pulp being obtained for this purpose by means of the boring rasp (Keil and Dolle). The officials of the company informed me that it was soon found that it would be absolutely impossible to analyze more than a small portion of the samples by this method with the facilities at their command. This method was, therefore, abandoned, and the indirect method adopted instead, as the latter method had been found suitable for rapid work by other sugar manufacturers. When the indirect method is employed, the percentage of sugar in the juice is determined, and the percentage of sugar in the beets is calculated therefrom by means of a factor. When the method was first adopted, the quantity of juice appropriate for each polarization was measured by means of a "sucrose pipette," the filling of the pipette being controlled by the density of the juice, which was previously determined by means of a Brix hydrometer. For greater accuracy the use of the "sucrose pipette" had been abandoned, and the method of direct weighing of each portion of juice used for polarization had been adopted before my arrival at the factory.

The method of analysis that I found in use on my arrival, and which was continued throughout the period of four days (December 19 to 22, 1899, inclusive) of my presence in the receiving laboratory was as follows:

Of each sample of juice, 52.1 grams was weighed on a small balance, a metal dish with brass counterweight being used to hold the juice during the weighing. From the dish the juice was rinsed into a 200-cubic-centimeter sugar flask by means of a jet of water supplied from a bottle of water standing on a shelf attached to the upper part of the laboratory wall; 6 cubic centimeters of solution of basic acetate of lead was added from a burette, and the liquid in the flask was diluted to nearly 200 cubic centimeters. The foam was dissipated by means of a drop or two of ether added from a dropping bottle. The volume of the solution was then completed to 200 cubic centimeters by means of water drawn from a small pet cock attached to a conveniently located pipe that connected with the city water supply. After thorough shaking, the mixture was filtered through a dry filter supported by a dry tin funnel, the filtrate being received in a dry glass cylinder. The tag, of which I have already spoken several times, and which had until now rested upon a nail opposite the cylinder that received the sample of juice as it flowed from the press, was now attached by means of its wire fastening to the cylinder that received the filtrate just mentioned.

The operations of weighing, washing into the flask, clarifying with basic lead acetate, completing the volume to 200 cubic centimeters, shaking, and filtering were performed for groups of ten samples at one time.

When ten filtrates had been obtained, they were polarized in a half-shadow Schmidt & Haensch polariscope in a 200-millimeter continuous tube. The scale of

---

lead acetate, and diluted to the mark. After shaking and filtering, the solution was polarized in a 200-millimeter tube, all the caution necessary to secure accuracy being observed during these operations.

c This result is considered as evidence of an overlapping with the juice of sample No. 1 rather than as evidence of a difference in the richness of the juice due to a difference in the pressure.

d The combined power of two men was applied to the lever of the press in order to obtain the second portion of juice in each case, but in the case of sample No. 4B only three-fourths of a cylinderful of juice could be obtained, although the pressure was maintained as strong as possible for several minutes, showing that the difference of pressure was as great in this case as the form of press permitted.

the polariscope employed unfortunately does not extend beyond 50° Ventzke, and the instrument does not permit of the use of a tube of greater length than 200 millimeters. A triple-field double-wedge compensation Schmidt & Haensch polariscope, with both dextro and levorotatory scales, graduated to 100° Ventzke, and capable of receiving a 400-millimeter tube, would not only facilitate accurate work, but would be more readily controlled by means of standard quartz plates, and the accuracy of any part of either scale could be tested by comparison with the other.

The zero reading of the instrument was read several times each day by the assistant chemist who made the polarizations, and all of the results corrected accordingly. The corrected reading was recorded on the tag, which was then dropped through a slot into a locked box, the key of which was carried by the clerk that recorded the results of taring and polarization.

At the time of my visit to the factory the method of determining the average percentage of total solids in the juice of the beets received each day was the subject of investigation by the company's chemist. The method of determining the density of each sample of juice by means of the Brix hydrometer was being compared with that of taking a definite volume of each sample of juice and placing it in a large bottle along with sufficient mercuric chlorid to prevent fermentation. This composite sample was thoroughly mixed, and its density determined by means of the Brix hydrometer at the close of each day's work. Since the portions of juice used for polarization were weighed, and not measured with a pipette, it is immaterial which method is employed for obtaining the daily average percentage of total solids, as the result is only needed for the calculation of the daily average coefficient of purity.

PRECAUTIONS NECESSARY TO ELIMINATE ERROR FROM QUANTITATIVE DETERMINATIONS OF SUGAR BY MEANS OF THE POLARISCOPE.

After observing the method of working in a general way, I next proceeded to investigate the care with which the chemists in the receiving laboratory were observing each of the several precautions which are indispensable to the accurate determination of sugar by means of the polariscope. These sources of error may be briefly enumerated as follows:

(1) Faulty construction of the apparatus used.
  (*a*) An inaccurate polariscope scale.
  (*b*) An observation tube of incorrect length.
  (*c*) Flasks incorrectly graduated.
  (*d*) Inaccurate weights.

(2) Incorrect manipulation.
  (*a*) Errors in weighing the portion of material to be used for each polarization.
  (*b*) Loss of some of the material between the time of weighing and the thorough mixing which precedes the filtration.
  (*c*) Error in diluting the liquid to the mark in the flask, which may be due to imprisoned air, or to not bringing the bottom of the meniscus exactly to the graduation mark.
  (*d*) Errors due to unclean or moist filters, funnels, glass cylinders, or other apparatus used in the filtration.
  (*e*) Error due to evaporation of the solution during filtration and while standing previous to polarization.
  (*f*) Error due to change of temperature and to the consequent change in the volume of the solution between the time of filling the flasks to the mark and the time of reading the solution in the observation tube.
  (*g*) Errors attending polarization made at other temperatures than 17.5° C., and due to the influence of temperature on the specific rotatory power of quartz and of sugar, as well as the influence of temperature on the dimensions of the observation tube, the flasks, and the apparatus employed generally.

Taking up these sources of error in the order named, I beg to report in regard to their relation to the results obtained in the laboratory under discussion, as follows:

The polariscope used was supplied by a firm whose instruments have an excellent reputation for careful workmanship, accuracy, and general excellence. However, the fact that this particular instrument was provided with only one pair of quartz wedges prevented my testing the accuracy of its scale by the method of comparing one scale with the other, which is in common use for polariscopes with double-wedge compensation. Moreover, I was unable to test the accuracy of its scale at about the point used by means of standard quartz plates, as the use of two plates, one levorotatory and one dextrorotatory, was impossible, owing to the shortness of trough provided for holding the observation tube.

I found the continuous-observation tube to be of correct length, as is witnessed by the following results of measurements with vernier calipers, reading to 0.01 millimeter:

Length of continuous-observation tube at 17.3° C., measured 3.20 a. m., December 22, 1899.

	Millimeters.
First measurement	200.05
Second measurement	200.00
Third measurement	200.00
Fourth measurement	199.95
Mean of four readings	200.00

The tube was rotated through an angle of about 90° after each reading.

The time at my disposal did not permit a thorough investigation of the accuracy of the flasks employed. I may say, however, that the close agreement of several duplicate polarizations that I made by use of these flasks in the course of my investigations in the laboratory under consideration precludes the possibility of any considerable inaccuracy in their graduation. Moreover, since an error of more than 0.5 cubic centimeter in the graduation of a 100-cubic centimeter flask is necessary to cause an error of 0.1 per cent in the polarization of a juice of average richness, it is extremely improbable that any of the flasks were sufficiently inaccurate to cause an appreciable error in the analysis of the juices. The general construction of the flasks in regard to form, maximum diameter of neck, etc., was good. It is to be hoped that the United States Office of Standard Weights and Measures will soon be able to offer the facilities of that office to commercial laboratories for the testing of flasks and other forms of apparatus. When this is done, apparatus can be purchased with the certificate of the Office of Weights and Measures, or with the guarantee that it is to stand the test of that office in regard to accuracy.

The double normal, or 52.1 grams, sugar weight used in weighing samples of juice for polarization was likewise found correct. When checked with a set of weights, of which the accuracy had been determined by the United States Office of Standard Weights and Measures, the weight was found to weigh 52.097 grams. This is nearer the true double normal weight than the marked value, 52.1 grams. A normal weight which is sometimes used in the work of the laboratory was also tested and found to weigh 26.046 grams, instead of 26.048 grams. This inaccuracy of 0.002 gram would cause an error of less that 0.01 per cent in the polarization of a granulated sugar, and an error of only about 0.001 per cent in the polarization of a juice of average richness.

Concerning errors due to improper or careless methods of manipulation, mentioned under (*a*), (*b*), (*c*), and (*d*), above, I must say that my observations, covering a period of four days, were most reassuring in regard to the care and cleanliness with which the various manipulations were conducted, in spite of the haste with which it was necessary to perform them. I was also forced to conclude, from observation, from conversation, and from records exhibited by the head chemist, that the laboratory force was constantly on the alert for an opportunity to improve the methods of manipulation in regard to accuracy and speed, and that the reliability of their methods had been checked whenever possible.

Evaporation of the solution during filtration and subsequent to polarization was reduced to a minimum by receiving the filtrates in tall, narrow cyclinders. Only a minimum surface of liquid was exposed to the air, and, as the cyclinders were without lips, the funnels fitted them closely, thus shutting out air currents that might otherwise have hastened evaporation.

The analysis of juice from cold beets in a warm room by use of water partly drawn from a pipe directly connected with the city water supply suggested to me at once a chance for error due to a change of the temperature of the solutions between the time of diluting them to the mark and the time of polarizing. The laboratory was kept at a fairly comfortable temperature by means of a steam coil. While the beets usually remained in the adjoining tare room for some time before the juice was expressed, it might sometimes occur that they were grated and pressed immediately after being brought from the winter temperature of the outer air. The hydrant water had a temperature of 6° to 8° C. when running full head from an ordinary-sized tap. My suspicion that the solution might be relatively very cold when made up to the mark and become many degrees warmer during the filtration and the period during which it waited its turn at the polariscope proved to be not well-founded. This is apparent from the following experiments:

Date.	Temperature of laboratory air.	Temperature of water from pet cock used for filling flasks to the mark.
December 20, 1899:	*Degrees C.*	*Degrees C.*
10 a. m	20.8	19.8
12 m	22.5	19.5
5 p. m	23.5	21.8
December 22, 1899: 10.45 a. m	22	26.5

The temperature of the juice samples as they entered the laboratory was taken several times during the afternoon of December 20, and was found to be 19°. The maximum difference between the temperature of the juice and the temperature of the room on that day was, therefore, less than 5°. The greater part of the water used had approximately the temperature of the room, since it came from the bottle mentioned above as located in the upper part of the room. The pipe leading to the pet cock, whence the remaining part of the water was drawn, extended for a considerable distance along the ceiling of the laboratory and at one point ran near a steam pipe, and thus the temperature of the water contained in it gradually approached that of the room. A change of 5° in the temperature of the solution between the time of making up to the mark and the time of polarizing makes an error of only about 0.01 per cent in the polarization of a juice of average richness; hence the error arising from the causes just discussed under the conditions set forth is negligible for the purpose of the analysis of beets to determine the purchase price. I would suggest, however, that it would be a wise precaution to take all of the water used from a reservoir located within the laboratory and filled long enough before use to allow it to acquire the temperature of the room. A thermometer should be hung up in the laboratory near the work able, where it can be inspected frequently, and precautions should be taken to avoid unnecessary fluctuations in the temperature of the room.

The errors mentioned above under (*g*) as due to the influence of temperature on the specific rotatory powers of quartz and sugar, and on the apparatus generally, are negligible in the polarization of a beet juice, except under extreme conditions. The correction does not reach 0.05 per cent with a juice polarizing 15° Ventzke until a temperature of 28° C. is reached.[1]

[1] See an article on this subject by H. W. Wiley, Journal of the American Chemical Society, 1899, **21**, 568–596.

FACTOR USED FOR CALCULATING PERCENTAGE OF SUGAR IN THE BEET FROM PERCENTAGE OF SUGAR IN THE JUICE.

The greatest source of difficulty connected with the indirect determination of the percentage of sugar in beets is the factor to be employed for calculating the percentage of sugar in the beet from the percentage of sugar in the juice. This arises from the fact that there is a considerable variation in the percentage of juice of the quality obtained by pressure contained in beets grown and stored under different conditions. It has been well established by the tolerably concordant results of numerous investigators that the normal percentage of fiber or marc (matter not juice) in the beet does not vary greatly from mean range of 4 to 5 per cent. If we compare the results of determinations of the percentage of sugar in the juice of the same beets, we find that our results show that the beets only contain juice of the quality expressed and analyzed equivalent to 89 to 95 per cent of the weight of the beet, or even less in the case of wilted beets, or of beets that have lost a considerable part of their water by exposure to the air.

The difference is readily understood when we recall the fact that the beet has an anatomy and histology (the structure of its various parts, distinguishable with the naked eye and with the microscope, respectively) just as animals have, and the fact that the juices from these different kinds of tissue have different chemical compositions just as the fluids have which come from the different organs of the animal body. When pressure is applied to the beet pulp, the juices escape first from the more yielding tissues, the juices flowing out of other tissues in the inverse order of their relative resistance to pressure; therefore the more intense the pressure the more nearly the sample will represent the average of all of the juices of the beet. The experiments reported above show that there is practically no difference in the juices expressed from a given sample of beet pulp by the extremes of light and heavy pressure obtainable with the lever press used in the receiving laboratory under discussion.

It had been the practice in that laboratory to use factors varying from 0.92 to 0.93, controlling them from time to time by determination of the percentage of sugar in the same sample of pulp, both by the indirect and by the direct method. The average quotient obtained by dividing the percentages of sugar in the beet by the corresponding percentages of sugar in the juice was taken as the factor indicated by each set of results. Just at the time of my investigations the factor in use was 0.915.

In the course of my investigations I made the following analyses in order to gain some knowledge of this factor and the amount of variation it undergoes with different samples of beets.

The first two samples of beets used in this investigation were selected in the beet sheds with the idea of obtaining one sample having a low percentage of sugar and another one having a high percentage of sugar. The sample designated "small beets" in the table of analytical data given below was composed of beets of the form and size considered typical for beets of high quality; the sample designated "large beets" in the table was composed of beets which were selected on account of their enormous size and general appearance as probably containing a small percentage of sugar; the samples designated by numbers were the regular load samples taken from the pile of baskets in the tare room without selection. For the samples designated "large beets" and "small beets" the press was cleaned and wiped dry before each pressing, and a dry, clean press cloth was used for each sample, thus eliminating the error due to the overlapping of the juices of successive samples. For the numbered samples the pressing was conducted in exactly the usual manner, with the exception that a slightly larger quantity of pulp than usual was used, in order to obtain two cylinderfuls of juice. The first cylinderful took the burden of the overlapping of the juice of the previous sample, and was used as the regular laboratory sample, representing the loads whence these samples came; the second cylinderful was used

for my own investigations. Each analysis was made in duplicate, with the exception of the Brix readings, and the duplicate results are indicated by the letters A and B. In the case of the hot alcoholic digestion method, the results marked A were obtained by half-hour digestion, while those marked B were obtained by one-hour digestion.

For the direct determination of the sugar in the beet the pulp was thoroughly mixed after it came from the grater and a portion reserved for analysis by the direct method in the case of the last four or five samples. In the case of the first three or four samples a duplicate set of quarters was taken and sent to the laboratory, where they were grated by hand and the pulp used for analysis by the direct method. Unfortunately, I omitted to note in my records whether three or four samples were treated by this method. I may say, however, that the fineness of the pulp obtained by the two methods was not greatly different. I personally supervised the entire process of preparing the samples, including the selection of the beets in the case of those selected in the sheds, the quartering, the grating, and the pressing of the pulp.

The total solids in the juices were determined by means of the Brix hydrometer. For the determination of the sugar in the juices double-normal portions were weighed and diluted to the mark in 100 cubic centimeter (Mohr's) flasks, after adding 6 cubic centimeters of solution of basic lead acetate having a density of 54.3° Brix. The analyses by the direct method were made by the hot alcoholic digestion method of Rapp-Degener, as described in Frühling und Schulz Anleitung zur untersuchung für die Zucker-Industrie, etc., fifth edition, pages 180–182. The numbers in the column headed "Factors" were obtained by dividing each percentage of sugar in the beet by the corresponding percentage of sugar in the juice. The manipulations were carried out with all possible care, and with due regard to the influence of temperature on the accuracy of the results. The calculations have been carefully checked.

Results of analyses of the juices and of the pulps from a series of samples of beets, made for the purpose of determining the relation of the percentage of sugar in the beet to the percentage of sugar in the expressed juice.

Samples.	Analyses of the juices.				Sugar in the beet determined directly by hot alcoholic digestion.		Factors.
	Total solids.	Sugar.		Coefficient of purity.	Duplicate results.	Means.	
		Duplicate results.	Means.				
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	
Small beets A	17.77	15.13	15.10	85.0	14.11	14.23	0.942
Small beets B		15.08			14.34		
Large beets A	16.47	13.17	13.15	79.8	12.43	12.42	0.944
Large beets B		13.13			12.40		
No. 8064 A	17.66	14.80	14.80	83.8	13.67	13.68	0.924
No. 8064 B		14.80			13.70		
No. 8069 A	17.81	14.58	14.58	81.9	13.10	13.15	0.902
No. 8069 B		14.59			13.19		
No. 8093 A	17.81	14.83	14.83	83.3	13.78	13.76	0.928
No. 8093 B		14.83			13.74		
No. 8103 A	18.28	15.78	15.78	86.3	14.62	14.61	0.926
No. 8103 B		15.78			14.60		
No. 8104 A	18.08	15.58	15.51	85.8	14.40	14.52	0.936
No. 8104 B		15.43			14.63		
No. 8105 A	18.08	15.95	15.93	88.1	14.57	14.63	0.918
No. 8105 B		15.90			14.69		
Mean of all samples							0.9275
Mean of load samples							0.9223

The figures in the foregoing table indicate that, for the quality of beets investigated, the factor varies from 0.902 to 0.945, and that 0.920 or 0.925 might well be

adopted as an equitable mean value. The two samples of selected beets gave the highest results for the factor 0.942 and 0.944, respectively. These high results are possibly due to the fact that, unconsciously, fresh, unwilted, juicy beets were selected. The mean of the entire series of eight comparative analyses was 0.9275, while the mean for the six load samples was 0.9223.

In this connection it is interesting to examine the extent of the error attending the use of a mean factor for a series of calculations when the factor appropriate for individual samples varies from 0.900 to 0.945, and the purchase price is $4 per ton for beets containing 12 per cent of sugar.

Variations in the purchase price of beets arising from the use of factors varying from 0.900 to 0.945.

Sugar in the juice.	Sugar in the beet and value per ton.					
	Using 0.900 as a factor.		Using 0.925 as a factor.		Using 0.945 as a factor.	
	Sugar in the beet.	Value per ton.	Sugar in the beet.	Value per ton.	Sugar in the beet.	Value per ton.
Per cent.	*Per cent.*		*Per cent.*		*Per cent.*	
10	9.0	$3.00	9.3	$3.10	9.5	$3.16
11	9.9	3.30	10.2	3.40	10.4	3.46
12	10.8	3.60	11.1	3.70	11.3	3.77
13	11.7	3.90	12.0	4.00	12.3	4.10
14	12.6	4.20	13.0	4.33	13.2	4.40
15	13.5	4.49	13.9	4.63	14.2	4.73
16	14.4	4.80	14.8	4.93	15.1	5.03
17	15.3	5.10	15.7	5.23	16.1	5.36
18	16.2	5.40	16.7	5.56	17.0	5.66
19	17.1	5.70	17.6	5.87	18.0	6.00
20	18.0	6.00	18.5	6.16	18.9	6.30

From this table it appears that by assuming 0.925 as the mean factor the price per ton would be from $0.10 to $0.16 per ton too high in individual cases in which the proper factor is 0.900, and $0.06 to $0.14 too low in individual cases in which 0.945 is the proper factor. These are, of course, the extreme cases; in the vast majority of cases the error must be well within these limits. These results, then, indicate the degree of accuracy attainable with certainty in the determination of sugar in the beet by the indirect method. These wide limits can be reduced with considerable certainty by making frequent control determinations; unless, however, a considerable number of these control analyses be made at one time, and the average be taken, the results may be misleading.

For commercial work of the kind in question, where a sliding scale of prices is to be maintained varying nearly from $3 to $6 per ton, the fixing of the price with reasonable certainty within $0.15 of the proper price in extreme cases, and in most cases much nearer, must be regarded as highly satisfactory. The results certainly justify the retaining of the indirect method of analysis unless the direct method can be substituted without great additional expense. I believe, however, that with proper apparatus for sampling and for performing the analytical work in a properly arranged, roomy laboratory, the direct method should not cost very considerably more either for labor or for apparatus and materials than does the indirect method. The work of the receiving laboratory would be greatly facilitated and accuracy rendered more easy of attainment if more space and a greater abundance of apparatus were provided. While I feel that the direct method of analysis possesses a sufficient number of advantages to justify the factory in trying it again next year with an abundance of the latest forms of apparatus, I feel that I can not urge too strongly the advantage of ample room and a good reserve stock of clean apparatus, whether the present method is to be retained or some other one adopted in its place. With a sufficient number of funnels and receiving jars, hot water for washing

them and ample facilities for draining and drying them, wiping with towels should be avoided entirely. This operation is not only expensive in point of labor and towels required, but it endangers accuracy through the possibility of the towels becoming wet or unclean.

Instead of performing the various operations connected with the analytical work in lots of ten as at present, space and apparatus should permit them to be performed in lots of at least fifty. Both speed and accuracy will be increased by this change.

ADDITIONAL DATA IN REGARD TO OVERLAPPING OF JUICES AT THE LEVER PRESS.

Before leaving the discussion of the receiving laboratory, I wish to present some additional data relative to the overlapping of the juices of successive samples at the press. When the pulps of the two selected samples of beets already mentioned were prepared for use in connection with the investigation of the factor to be used for calculating percentages of sugar in the juice to percentages of sugar in the beet the pulped samples were thoroughly mixed, and duplicate portions were pressed in the ordinary way without any unusual precautions to prevent the overlapping of the juices. The results of the analyses of these juices, together with the results given above and obtained with samples of juices from the same pulps pressed with every precaution to avoid overlapping of the juices, are placed in the following table for comparison:

Analytical results indicating the error due, in extreme cases, to the overlapping of the juices of successive samples in the press.

Samples.	Total solids by Brix hydrometer.	Sugar in the juice.		Purity.
		Duplicates.	Means.	
Pulp pressed in the usual manner:	*Per cent.*		*Per cent.*	
Small beets	17.03	14.33 14.41	14.37	74.4
Large beets	16.50	13.33 13.35	13.34	80.8
Pulp pressed with precautions to avoid overlapping of the juice (press cleaned and wiped and a fresh press cloth used for each sample):				
Small beets	17.77	15.13 15.08	15.10	85
Large beets	16.47	13.17 13.13	13.15	79.8

These results confirm the observations made earlier in this report and show that the error due to this cause may be very considerable when two successive samples of beets have juices of widely different richness.

SAMPLES OF SUGAR BEETS RECEIVED AND ANALYZED AT THE DEPARTMENT OF AGRICULTURE.

In the following table are given the results of the analyses of the samples of sugar beets received at the Department of Agriculture from the various States and Territories. These samples were sent by mail wrapped in oil paper to prevent evaporation in accordance with instructions for harvesting, sampling, and mailing sent out by the Department. Most of them arrived in excellent condition, especially when the directions had been minutely followed. A few of the samples showed signs of wilting, owing to inattention to directions or too long detention en route.

The table shows (1) the serial number which was attached to each sample as it came in; (2) the county and post-office from which the sample was sent; (3) the name of the person sending the beets; (4) a statement of the variety; and (5) the analytical data. The average weight of the beet is given in ounces, and the percentage of sugar in the beet is represented by a figure obtained by multiplying the polarization of the expressed juice by the factor 0.95. The figures under the head "Purity" denote the quantity of pure sugar in 100 parts of dry material, as found in the juice of the beet; for instance the number 68 means that in 100 pounds of dry material, obtained by expressing the juice of the beets, 68 pounds are pure sugar.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States.

[The symbol following name of county indicates the location of the county within the State, as follows: □, central; ⊔, northern; □-, eastern; ⊓, southern; -□, western; ⌝□, northwestern; ⌜□, northeastern; ⌟□, southeastern; ⌞□, southwestern.]

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	ARKANSAS.							
					Ounces.	*Per cent.*	*Per cent.*	
13	Lawrence ⌜□	Portia	J. J. Fletcher	Kleinwanzlebener	15	8.3	68.0	No.
9	....do	....do	....do	....do	17	6.4	60.0	No.
46	Little River ⌞□	Pineprairie	J. S. Potts		24	3.5	39.3	No.
47	....do	....do	....do		15	5.7	57.1	No.
5	Nevada ⌞□	Prescott	Mrs. T. W. Wilson	Vilmorin	6	6.2	53.2	No.
	State averages (5 samples).				15	6.0	55.5	
	CALIFORNIA.							
11	San Bernardino ⌞□	Chino	Chino Valley Beet Sugar Company.	Vilmorin's Improved	11	13.9	82.0	No.
	State averages (1 sample).				11	13.9	82.0	
	COLORADO.							
574	Arapahoe □	Cope	J. C. Cope		29	11.4	79.5	No.
815	....do	Henderson	J. F. Robinson	Kleinwanzlebener	33	14.6	83.2	Yes.
391	Costilla ⊓	Alamosa	G. W. Shaw	Vilmorin's Improved	19	12.6	77.4	No.
941	Dolores ⌞□	Lavender	H. M. Knight	....do	32	14.7	79.5	No.
521	Douglas □	Castlerock	D. C. Dorner	Kleinwanzlebener	21	12.8	73.3	No.
336	Elbert □-	Fondis	Wm. Duffey	Vilmorin's Improved	16	12.3	68.6	No.
435	El Paso □	Husted	W. T. Wilson	Kleinwanzlebener	15	12.8	74.6	No.
728	....do	....do	H. J. Wilson	Vilmorin's Improved	22	12.0	72.8	Yes.
812	Fremont □	Canon City	J. M Mortimer	Zehringen	32	17.9	85.1	No.
822	....do	....do	....do	....do	36	16.3	84.3	No.
833	....do	....do	H. T. Gravestock	....do	10	20.5	90.8	Yes.
831	....do	....do	....do	....do	12	19.6	86.9	Yes.
829	....do	....do	C. H. Gravestock	....do	11	17.1	85.3	Yes.
839	....do	....do	....do	....do	11	19.4	88.3	Yes.
838	....do	....do	H. T. Gravestock	....do	13	20.3	88.4	Yes.
837	....do	....do	....do	....do	14	17.5	84.0	Yes.
840	....do	....do	C. H. Gravestock	....do	14	19.5	90.3	Yes.
847	....do	....do	....do	....do	14	18.6	89.1	Yes.
654	Garfield ⌝□	Carbondale	D. G. Edgerton	....do	20	15.2	86.5	Yes.

653	....do	....do	.... do	....do	10	14.1	84.1	Yes.
946	....do	....do	....do	....do	13	14.7	83.3	No.
947	....do	....do	....do	....do	14	15.1	85.0	No.
948	....do	Antlers	C. H. Miller	....do	18	14.5	79.3	No.
970	....do	....do	....do	....do	13	14.1	77.9	No.
979	....do	....do	....do	....do	13	15.8	82.2	No.
170	Larimer ⊔	Fort Collins	W. W. Cooke	....do	13	14.8	78.8	
777	....do	Loveland	J. W. Clapper	....do	47	16.0	82.8	Yes.
778	....do	....do	....do	....do	9	13.6	76.5	No.
780	....do	....do	....do	....do	29	14.2	84.2	Yes.
798	....do	....do	....do	....do	13	16.3	85.1	No.
80	Logan ⊏	Sterling	J. W. Landrum	Kleinwanzlebener	25	14.7	82.4	Yes.
113	....do	Leroy	A. Steinhardt	....do	11	12.5	75.0	No.
103	....do	....do	....do	....do	17	11.3	75.4	No.
529	....do	Sterling	F. Bernhard	Zehringen	33	15.8	81.4	No.
509	....do	....do	....do	....do	36	15.7	78.9	No.
502	Mesa ⊐	Clover	G. B. Sanford	....do	39	13.1	76.7	Yes.
763	....do	Collbran	W. K. Sterling	Kleinwanzlebener	79	14.1	77.1	Medium.
767	....do	....do	....do	....do	31	13.6	79.9	Medium.
770	....do	Vega	J. Jackson	....do	33	10.0	66.9	No.
893	....do	Debeque	A. May	Zehringen	24	13.6	78.6	No.
892	....do	....do	....do	....do	33	13.6	77.7	No.
885	....do	....do	....do	....do	31	14.3	82.9	No.
881	....do	....do	....do	....do	34	12.4	76.5	No.
78	Montrose ⊐	Montrose	W. T. Collison		39	10.0	70.5	Yes.
29	Morgan ⊏	Fort Morgan	S. M. Scott	Vilmorin's Improved	17	13.0	74.4	No.
804	Otero ⊔	Rockyford	B. F. Wyckoff	Zehringen	25	11.6	73.9	No.
999	....do	....do	W. Mathews		61	11.7	73.3	No.
977	....do	....do	....do		38	13.3	76.9	
32	Prowers ⊔	Lamar	M. D. Parmeter	Vilmorin's Improved	20	11.7	78.8	No.
35	....do	Holly	L. Challin	....do	11	13.5	80.7	No.
69	....do	Lamar	E. W. Fuller	Kleinwanzlebener	8	12.1	78.4	No.
474	....do	Holly	L. Challin	Vilmorin's Improved	19	11.0	76.3	No.
807	....do	Lamar	M. D. Parmeter	Zehringen	19	12.2	75.7	No.
816	....do	....do	....do	....do	28	14.0	79.9	No.
824	....do	....do	....do	....do	22	10.5	71.9	No.
826	....do	....do	....do	....do	21	13.1	76.7	No.
817	Weld ⊏	Greeley	M. Nelson	....do	31	15.1	83.3	No.
821	....do	....do	....do	....do	22	16.2	86.7	No.
886	....do	Evans	F. Niemeyer	....do	36	14.2	83.7	Yes.
898	....do	....do	....do	....do	17	16.6	85.8	Yes
813	....do	Greeley	M. Nelson	....do	24	16.7	85.9	No.
814	....do	....do	....do	....do	29	17.0	84.0	No.
897	....do	Evans	F. Niemeyer	....do	31	14.3	78 9	Yes.
894	....do	....do	....do	....do	43	13.8	81.0	Yes.
	State averages (64 samples).				24	14.4	80.2	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	CONNECTICUT.				*Ounces.*	*Per cent.*	*Per cent.*	
132	Fairfield	Darien	J. W. Mather	Vilmorin's Improved	13	10.3	76.6	No.
779	do	do	do	do	20	11.5	74.3	No.
	State averages (2 samples).				17	10.9	75.5	
	DELAWARE.							
171	Sussex	Coolspring	G. A. Coverdale	Vilmorin's Improved	22	13.1	81.2	No.
856	do	do	do		26	11.8	81.6	
	State averages (2 samples).				24	12.5	81.4	
	DISTRICT OF COLUMBIA.							
541	District of Columbia	Washington	Dr. H. W. Wiley	Mangold	14	6.3	55.9	
542	do	do	do	Vilmorin's Improved	16	5.1	50.4	
555	do	do	do	Zehringen	35	6.3	59.4	
556	do	do	do	Kleinwanzlebener	29	7.8	61.7	
	State averages (4 samples).				24	6.4	56.9	
	GEORGIA.							
800	Cobb	Hardage	Miss L. E. Hardage		14	16.2	86.3	No.
850	do	do	do	Kleinwanzlebener	27	12.5	76.2	No.
801	do	do	do		11	14.4	78.8	No.
142	Floyd	Rome	J. L. Johnson		6	11.0	75.3	No.
994	do	do	W. H. Mitchell		19	9.4	65.1	No.
17	Oglethorpe	Crawford	R. L. Norgrove	Zehringen	16	9.8	77.5	No.
34	Spalding	Experiment	Georgia Experiment Station	Vilmorin's Improved	8	10.7	69.7	No.
61	do	do	do	Mangold	10	10.6	81.8	No.
62	do	do	do	Biendorf Elite Klienwanzlebener.	15	7.0	69.8	No.
60	do	do	do		15	8.4	69.3	No.
	State averages (10 samples).				14	11.0	75.0	
	IDAHO.							
477	Fremont	Market Lane	C. Osterock	Vilmorin's Improved	36	10.8	75.0	No.
	State averages (1 sample).				36	10.8	75.0	

	ILLINOIS.							
67	Boone	Belvidere	J. C. Moss	Kleinwanzlebener	11	14.4	77.5	No.
271	Cook	Chicago	H. L. Smith	Vilmorin's Improved	15	10.6	73.7	Yes.
626	do	Oakglen	J. Rietveld	Zehringen	20	11.8	81.0	Yes.
617	do	do	do	Biendorf Elite Kleinwanzlebener	21	11.2	80.3	Yes.
237	Dupage	Wayne	G. W. Pickering	Vilmorin's Improved	13	12.7	76.6	Medium.
238	do	do	do	do	10	11.7	76.3	Medium.
903	do	Meacham	F. W. Pfingsten	Kleinwanzlebener	28	12.5	80.5	No.
8	Jasper	Bogota	J. Michels	Vilmorin's Improved	12	9.4	66.9	Yes.
97	Kane	Elgin	F. C. Nolting	Zehringen	47	6.5	63.0	No.
236	do	do	D. B. Smith		24	10.6	73.4	No.
443	do	do	E. M. Starr	Kleinwanzlebener	36	9.1	64.0	No.
466	do	do	L. A. Klebes		49	8.7	63.8	Yes.
469	do	do	do		36	10.8	70.8	Yes.
729	do	do	J. W. Owen	Kleinwanzlebener	21	12.9	74.6	Yes.
722	do	do	P. Whipple	do	38	12.5	79.5	Yes.
258	Lee	Dixon	T. Roberts	Zehringen	13	9.6	66.8	No.
698	Livingston	Fairburg	H. J. Ramey	do	20	10.8	79.2	No.
696	do	do	do	do	21	10.5	73.3	No.
688	Macon	Decatur	A. Barnes	Vilmorin's Improved	26	12.7	76.1	
374	Menard	Athens	C. A. Nelson	Imperial	26	7.7	67.0	Yes.
670	Mercer	New Windsor	A. L. Woodhams		26	8.2	67.2	No.
119	Rock Island	Rock Island	T. Campbell		30	8.3	67.5	Yes.
27	St. Clair	Rentchler	H. Gauch		46	6.9	64.0	No.
333	do	Shiloh	J. P. Alexander		25	9.8	68.6	No.
796	Sangamon	Springfield	J. F. Miller	Kleinwanzlebener	15	14.8	83.9	Yes.
	State averages (25 samples).				25	10.6	72.6	
	INDIANA.							
233	Allen	Chamberlain	Wm. S. Ringwalt	Kleinwanzlebener	59	10.4	72.2	Yes.
932	Dearborn	Wilmington	E. Kerr	Vilmorin's Improved	15	12.6	77.8	No.
680	Elkhart	Bristol	L. H. Girton	Kleinwanzlebener	17	13.1	82.6	No.
756	Franklin	Brookville	J. C. Shirk	do	9	14.5	77.3	Yes.
94	Grant	Swayzee	A. Martin		30	10.1	67.9	Yes.
151	do	do	G. Weisembarger	Kleinwanzlebener	18	11.3	76.3	No.
204	Henry	New Lisbon	W. Gilbert	do	8	13.8	80.1	No.
586	do	Lewisville	J. Parker	do	16	12.4	78.8	Medium.
585	do	do	do	do	12	10.1	68.4	Yes.
926	do	Newcastle	F. L. Waters	do	30	10.7	71.5	No.
165	Howard	Oakford	C. J. Falk	Vilmorin's Improved	6	10.2	70.4	Yes.
21	Lake	Dyer	Wm. Teutemacher		37	8.7	59.0	No.
459	do	Shelby	Lake Agricultural College		10	12.8	80.4	Yes.
449	do	do	P. J. Larson		12	10.6	60.3	Yes.
446	do	do	J. Latta		15	8.6	70.3	Yes.
139	Perry	Rome	J. J. Wheeler	Vilmorin's Improved	15	10.1	61.1	No.
674	do	Bristow	H. C. L. Pyle		5	12.4		Yes.
747	do	Rome	J. J. Wheeler	Vilmorin's Improved	18	9.6	73.2	No.
356	Ripley	Crossplains	M. Cooper		8	9.8	71.0	Yes.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	INDIANA—continued.							
					Ounces.	*Per cent.*	*Per cent.*	
16	Shelby	Morristown	A. V. Wagoner		7	9.9	72.7	Yes.
379	do	do	do		11	12.9	86.1	Yes.
143	Starke	North Judson	F. Ross	Kleinwanzlebener	7	14.0	80.8	No.
207	do	San Pierre	Mrs. P. Kramer	Vilmorin's Improved	11	9.9	73.2	No.
15	Sullivan	Narrows	H. H. Van Vleck	Kleinwanzlebener	13	9.5	67.5	Yes.
68	Tipton	Curtisville	J. G. Vollstadt		18	12.3	76.7	No.
971	do	Elwood	J. C. Millikan		34	11.9	74.0	Yes.
978	do	Tipton	W. G. Nash		19	13.8	78.0	Yes.
482	Wayne	Richmond	F. Aue		26	10.6	69.8	Yes.
130	Whitley	South Whitley	T. Kreider	Kleinwanzlebener	55	12.6	76.5	Yes.
	State averages (29 samples).				19	11.4	73.4	
	IOWA.							
28	Audubon	Exira	P. I. Whitted	Kleinwanzlebener	40	9.5	69.4	Yes.
515	Benton	Vinton	W. S. Furry	Mangold	31	12.1	83.0	No.
66	Blackhawk	Eagle Center	J. Schaefer		21	14.3	77.7	Yes.
393	do	do	do		18	13.6	79.0	Yes.
369	Bremer	Grovehill	H. Fuhr		21	12.6	72.7	No.
362	do	do	do		16	11.1	66.5	No.
85	Cerro Gordo	Clearlake	W. Brayton	Kleinwanzlebener	18	13.0	78.7	No.
84	do	do	C. Hengse	do	19	14.6	80.6	No.
83	do	do	T. Palmer	do	19	11.8	77.0	No.
190	do	do	D. P. Calkins		16	12.7	72.4	No.
499	do	do	C. H. Hugil	Kleinwanzlebener	18	14.1	81.3	No.
500	do	do	A. Greenup	do	16	15.2	83.3	No.
498	do	do	T. Palmeter	do	17	12.6	74.7	No.
33	Cherokee	Cherokee	Z. A. Wellman	do	12	10.1	67.5	No.
59	do	do	L. D. Nelson		24	8.4	65.2	No.
99	do	do	J. Gudden		21	12.3	79.7	Yes.
275	do	Meriden	R. Miles		36	11.7	77.9	Yes.
397	do	Cherokee	W. M. Little		19	11.3	75.7	No.
536	do	do	H. P. Shedd		30	3.9	46.0	
24	Crawford	Dow City	Wm. Jenkins	Kleinwanzlebener	30	9.5	67.1	No.
305	do	do	E. J. Ballenger	do	20	10.3	71.1	No.
540	do	do	Wm. Jenkins	do	36	10.6	72.3	No.
52	Dickinson	Spirit Lake	S. E. Rhoads	do	54	10.2	69.9	No.
145	do	do	do	do	27	6.8	55.8	No.
441	do	do	do	do	34	7.9	61.0	No.

690	....do	....do	....do	....do	26	9.6	67.4	No.
774	....do	Lakepark	I. L. Breffle		15	9.4	66.4	Yes.
773	....do	....do	....do		27	12.4	61.0	Yes.
658	Fayette	Hawkeye	B. S. Bemis	Kleinwanzlebener	32	7.2	56.7	Yes.
633	....do	Elgin	F. G. Matthys	....do	14	12.7	79.8	
177	Franklin	Hampton	F. Dohrmann		18	10.9	70.1	No.
631	....do	....do	....do		23	19.1	69.7	Yes.
25	Fremont	Bartlett	L. Chambers		27	6.9	61.9	Yes.
452	....do	....do	....do		35	9.9	69.8	No.
135	Greene	Jefferson	Wm. Hopper	Kleinwanzlebener	24	13.4	73.4	No.
38	Hancock	Britt	J. E. Gifford	....do	39	9.5	68.0	Yes.
481	....do	....do	G. P. Hardwick	Vilmorin's Improved	22	12.1	73.4	Yes.
480	....do	....do	....do	Kleinwanzlebener	15	12.9	76.0	Yes.
479	....do	....do	....do	....do	23	11.6	73.1	Yes.
924	....do	....do	J. E. Gifford	....do	55	9.9	70.7	No.
192	Keokuk	Hedrick	J. T. Brooks	....do	10	11.2	71.5	No.
193	....do	....do	J. Morrison	....do	10	10.7	73.4	No.
209	....do	Hayesville	J. F. Doser	....do	12	11.7	78.4	No.
270	Madison	Winterset	Z. G. Cooley	....do	19	10.2	73.3	No.
260	Mahaska	Taintor	O. R. Phelps	....do	12	9.8	74.1	No.
37	Marion	Tracy	W. K. Rowze	....do	13	9.6	67.7	No.
354	....do	....do	....do	....do	18	11.7	71.9	No.
396	Marshall	Marshalltown	W. A. Cope		13	11.6	74.8	No.
370	Mills	Malvern	P. Kilmartin	Kleinwanzlebener	20	8.8	68.4	No.
77	Montgomery	Stanton	A. Trabert		27	9.9	70.3	No.
73	....do	Stennett	E. P. Milner	Kleinwanzlebener	26	8.9	71.8	No.
200	....do	Stanton	A. Trabert	....do	33	11.4	75.9	No.
206	....do	Stennett	J. J. Abbott		17	10.3	73.0	Yes.
221	....do	....do	E. P. Milner		24	9.0	66.4	No.
367	....do	Redoak	Wm. M. Murphy	Vilmorin's Improved	10	12.0	74.1	Yes.
368	....do	....do	....do	Klienwanzlebener	13	12.4	74.7	Yes.
476	....do	Elliott	J. H. Moore	....do	29	10.8	71.3	No.
72	O'Brien	Primghar	P. R. Bailey	....do	27	12.7	76.1	Yes.
122	....do	....do	....do	....do	42	11.7	72.3	Yes.
42	Palo Alto	Emmetsburg	M. Voigt	....do	15	9.3	68.1	Yes.
43	....do	....do	....do	....do	19	10.9	76.2	Yes.
191	....do	Fairville	F. Witte	....do	37	11.0	76.3	No.
219	Pottawattamie	Underwood	F. H. Klopping		26	11.0	76.3	Yes.
618	Winneshiek	Decorah	F. B. Tillotson	Kleinwanzlebener	62	11.4	78.9	Yes.
656	....do	....do	J. Erickson	Mangold	39	11.0	76.3	Yes.
659	....do	....do	....do	....do	20	10.3	76.1	Yes.
571	Woodbury	Sioux City	R. U. Search	Vilmorin's Improved	28	13.3	80.5	No.
	State averages (67 samples).				24	10.9	72.1	
	KANSAS.							
224	Allen	Humboldt	Wm. Overbolt	Kleinwanzlebener	45	6.9	54.4	
225	....do	....do	C. H. Pratt	....do	25	8.5	59.3	
220	....do	Laharpe	E. D. Kramer	....do	27	7.4	63.4	
223	....do	....do	A. Nelson	....do	19	9.7	63.7	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	KANSAS—continued.				*Ounces.*	*Per cent.*	*Per cent.*	
996	Allen	Iola	C. Barth	Kleinwanzlebener	22	6.9	53.9	No.
980	do	do	J. Rosenberg	do	15	13.0	76.1	
983	do	do	E. Ratliff	do	27	11.7	74.1	No.
989	do	do	G. Fackle	do	26	7.6	62.5	No.
365	Barton □	Ellinwood	A. Roth	do	27	9.9	68.8	Yes.
548	do	Liberal	E. E. Rielenour	do	31	5.3	51.4	No.
543	do	do	do		25	5.5	55.2	Medium.
547	do	do	G. W. Nelson	Kleinwanzlebener	29	8.2	58.1	No.
545	do	do	—— McIntosh	do	18	8.5	65.4	No.
852	do	Ellinwood	A. Roth	do	22	9.9	70.3	Yes.
74	Bourbon □	Fort Scott	H. D. Smith	do	24	7.9	62.0	No.
81	do	do	Wm. Heath	do	24	10.6	72.3	Yes.
158	do	do	Captain Nelson	do	12	7.5	60.7	No.
161	do	do	F. Finney	do	7	10.1	70.7	No.
156	do	do	M. V. Walker	do	17	12.1	61.0	No.
129	do	do	G. H. McComb	do	15	12.5	74.5	Yes.
106	do	do	H. Taylor	do	29	10.7	70.6	Yes.
128	do	Godfrey	A. Hunley	do	14	13.0	74.0	Yes.
226	do	do	R. Ewing	do	8	14.0	71.7	
550	do	Fort Scott	W. C. Gunn	do	16	12.9	79.5	
699	do	do	A. Hunles	do	7	13.6	82.2	No.
695	do	do	—— Bartam	do	8	12.0	81.8	No.
703	do	do	G. H. McComb	do	9	13.0	78.3	No.
876	do	do	W. C. Gunn	do	17	12.0	71.2	No.
986	do	do	L. Neal	do	26	6.8	56.2	No.
108	Doniphan □	Troy	R. H. Montgomery	Vilmorin's Improved	32	7.9	67.5	Yes.
484	Miami □	Block	A. Lister	Kleinwanzlebener	14	5.7	45.4	No.
478	do	do	J. Daggefort	do	24	8.6	58.4	No.
943	do	Paola	P. Marguard	do	21	10.6	70.9	No.
3	Reno □	Nickerson	W. H. Ritcha	do	33	7.4	62.4	Yes.
4	do	do	do	do	32	7.3	63.6	Yes.
	State averages (35 samples).				22	9.6	66.0	
	KENTUCKY.							
239	Rockcastle □	Mount Vernon	W. B. Whitehead	Vilmorin's Improved	5	7.4		
	State averages (1 sample).				5	7.4		

	MARYLAND.							
407	Cecil	Woodlawn	J. T. Rutter	Vilmorin's Improved	28	10.3	74.0	No.
1	Charles	Bryantown	J. B. W. Gardiner		7	11.0	76.8	No.
2	do	do	do		6	11.3	78.8	No.
90	Frederick	Frederick	D. C. Kemp	Kleinwanzlebener	20	9.3	72.1	No.
41	do	Araby	E. F. Tucker	do	27	8.9	71.8	No.
632	Worcester	Pocomoke City	H. J. Mitchell	do	20	10.2	74.3	No.
	State averages (6 samples).				18	10.2	74.6	
	MASSACHUSETTS.							
904	Hampshire	Amherst	Hatch Experiment Station	Kleinwanzlebener	17	13.9	83.9	Yes.
908	do	do	do	Rolker's Improved	21	14.8	78.4	Yes.
905	do	do	do	Kleinwanzlebener	18	14.8	85.7	Yes.
907	do	do	do	Vilmorin's Improved	21	15.1	85.5	Yes.
906	do	do	do	Kleinwanzlebener	22	14.2	85.6	Yes.
911	do	do	do	do	25	14.5	78.1	Yes.
909	do	do	do	Rolker's Improved	25	16.0	86.6	Yes.
910	do	do	do	Vilmorin's Improved	20	15.5	87.7	Yes.
938	Plymouth	Plymouth	E. E. Avery	do	17	12.2	78.0	No.
	State averages (9 samples).				21	14.6	83.3	
	MICHIGAN.							
343	Allegan	Allegan	W. H. Warner, jr	Vilmorin's Improved	16	12.4	81.2	No.
792	do	Cheshire	Dr. S. S. Stout	Kleinwanzlebener	24	12.6	79.2	No.
877	do	Allegan	W. H. Warner, jr	Vilmorin's Improved	17	12.8	77.6	No.
539	Baraga	L'Anse	J. Q. McKennon		28	11.8	72.0	Yes.
252	Bay	West Bay City	J. T. Leinberger	Vilmorin's Improved	19	14.2	82.3	No.
254	do	do	J. G. Schmidt	do	17	14.6	81.5	No.
952	do	do	C. Pauer	Kleinwanzlebener	13	12.5	82.0	No.
687	Berrien	Buchanan	J. P. Geyer		8	14.0	85.5	No.
702	do	do	do	Kleinwanzlebener	29	13.7	81.8	No.
104	Calhoun	Athens	A. J. Eastman		17	11.9	79.6	No.
438	Clinton	Riley	G. F. Ottmar	Vilmorin's Improved	6	12.7	78.4	No.
951	do	do	do	do	10	13.7	82.4	No.
75	Eaton	Eaton Rapids	Edson Depue	do	27	11.4	76.4	No.
581	do	Kalamo	E. M. Baker	do	6	12.5	77.5	No.
899	do	do	do	do	12	14.0	81.7	No.
955	do	Mulliken	William N. Triphagen		17	12.5	73.7	No.
98	Emmet	Cross Village	J. P. Gretsch		29	10.6	74.5	No.
583	Genesee	Fenton	H. B. Latourette	Vilmorin's Improved	59	12.6	72.2	Yes.
91	Gratiot	Edgewood	C. S. Betts	Zehringen	22	12.0	80.3	No.
82	do	Sickles	A. L. Wight	Kleinwanzlebener	17	12.5	79.5	No.
582	do	do	do	do	15	13.2	79.0	No.
519	Hillsdale	Hillsdale	S. D. Procter		21	13.3	81.9	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	MICHIGAN—continued.							
					Ounces.	*Per cent.*	*Per cent.*	
988	Hillsdale	Scipio	D. E. Haskins	Kleinwanzlebener	18	11.3	75.8	Yes.
562	Ionia	Ionia	A. Konklin	do	33	9.9	68.0	
564	do	do	E. W. Bryant	do	39	9.5	67.6	No.
428	Iosco	Tawas City	P. C. Goldin	do	19	15.0	82.3	No.
569	do	do	do	do	25	14.4	81.3	No.
248	Iron	Iron River	J. S. Kinney	Vilmorin's Improved	27	13.3	80.5	No.
859	Jackson	Jackson	P. E. Pierce	do	19	15.6	83.7	No.
864	do	do	do	do	13	15.2	82.9	No.
882	do	do	G. S. Dewey		23	11.8	76.5	No.
935	do	do	F. A. Doney	Vilmorin's Improved	37	11.8	77.0	No.
914	do	do	do	Zehringen	24	11.2	76.6	No.
960	do	Grass Lake	M. Preston	Kleinwanzlebener	24	13.8	85.8	Yes
136	Lake	Oliver	F. Edwards	do	13	12.9	81.0	No.
558	Lapeer	Imlay City	H. Lengemann	do	21	11.8	78.0	No.
803	do	do	E. E. Palmer	Biendorf Elite Kleinwanzlebener	13	14.3	83.8	No.
155	Lenawee	North Morenci	H. C. Smith		19	13.7	81.4	No.
933	do	do	A. O. Sutton	Zehringen	21	14.1	83.6	No.
939	do	do	A. W. Sutton		18	13.5	84.0	No.
157	Livingston	East Cohoctah	M. M. Betterly	Kleinwanzlebener	32	10.6	73.0	No.
488	Luce	Newberry	C. Brebner	do	26	13.5	81.6	No.
342	Macomb	Disco	Mr. Lawson	Vilmorin's Improved	11	14.4	85.3	No.
344	do	do	do	do	13	14.0	85.5	No.
93	do	Utica	A. R. Hahn	Kleinwanzlebener	18	12.6	77.4	No.
532	do	do	J. H. Sweitzer	do	26	12.6	82.6	No.
597	do	Armada	G. Cryderman	do	36	12.3	78.7	No.
600	do	do	do	do	28	13.9	82.0	No.
611	do	Mount Vernon	C. L. Lockwood	Zehringen	24	13.3	80.0	No.
636	do	Richmond	Miss A. Pohnke		14	15.2	84.7	No.
753	do	Utica	J. H. Sweitzer	Kleinwanzlebener	18	14.3	83.3	No.
214	Marquette	Marquette	J. M. Longyear		13	14.7	79.9	
215	do	do	do		16	14.2	77.6	
216	do	do	C. Vittlar	Vilmorin's Improved	16	15.9	85.7	No.
217	do	Yalmar	E. Stewart	Zehringen	18	13.4	78.8	No.
218	do	Green Garden	J. Barry	Vilmorin's Improved	17	12.6	77.8	No.
228	do	Yalmar	C. E. Johnson	do	25	13.8	81.0	
227	do	Marquette	J. Harris	Kleinwanzlebener	35	13.7	77.4	No.
229	do	do	F. Johnson	Vilmorin's Improved	26	14.4	80.4	No.
230	do	do	M. Guelff	Kleinwanzlebener	22	15.2	84.2	No.
36	Mason	Ludington	A. H. Nordhouse	do	33	11.5	77.1	No.
53	do	do	J. D. Hoogstradt	do	16	13.9	82.5	Yes.
56	do	Fountain	Wm. Flanagan		11	13.7	81.8	No.
112	do	Scottville	Wm. R. Quinn		11	14.0	30.8	Yes.

256	.....do	Ludington	P. Ewing		25	14.0	80.3	No.
399	.....do	.....do	H. C. Ransom	Vilmorin's Improved	19	13.5	78.9	No.
358	.....do	.....do	C. Dahn	.....do	34	14.1	86.0	Yes.
551	.....do	.....do	J. H. Conrad	Kleinwanzlebener	37	14.6	84.2	No.
609	.....do	Riverton	R. Jameson	Vilmorin's Improved	26	13.9	80.7	No.
601	.....do	Victory	A. Daw		26	13.6	79.5	No.
613	.....do	Wesley	Wm. Warner		32	13.6	78.6	Yes.
644	.....do	.....do	.....do		25	16.0	86.6	No.
786	.....do	.....do	G. F. Piper	Kleinwanzlebener	13	14.1	82.2	Yes.
739	.....do	Ludington	J. Pehrson	Zehringen	36	12.5	81.0	No.
868	.....do	.....do	J. D. Hoogstradt	Kleinwanzlebener	19	13.6	80.8	Yes.
10	Mecosta □	Morley	C. Van Gelder	.....do	14	10.6	79.3	No.
70	.....do	Borland	C. F. Kiefer	Vilmorin's Improved	18	13.8	84.3	No.
100	.....do	Rodney	W. F. Zehnzen	.....do	15	12.4	79.3	No.
118	.....do	Morley	I. Sanford		23	11.3	80.4	Yes.
489	.....do	.....do	J. Buckley	Vilmorin's Improved	26	13.5	84.5	No.
527	.....do	.....do	I. Sanford	Kleinwanzlebener	19	10.6	76.6	Yes.
587	.....do	Borland	C. F. Kiefer	Vilmorin's Improved	27	13.2	82.2	No.
619	.....do	Emerald	G. E. Sparks	Kleinwanzlebener	29	13.5	80.7	Yes.
640	Menominee □	Bagley	J. Hewring		9	14.1	79.6	
186	Monroe □	Monroe	E. C. Post	Zehringen	32	10.9	74.7	No.
183	.....do	.....do	.....do	Vilmorin's Improved	31	14.0	82.6	Yes.
181	.....do	.....do	.....do	.....do	28	11.4	75.9	No.
175	.....do	.....do	.....do	Zehringen	23	12.5	74.5	Yes.
172	.....do	.....do	G. F. T. Kipp	.....do	42	10.3	61.6	No.
169	.....do	.....do	E. C. Post	.....do	24	14.1	82.2	No.
167	.....do	.....do	.....do	.....do	11	12.7	80.7	No.
164	.....do	.....do	A. Midermeyer	.....do	26	12.0	77.8	
163	.....do	.....do	.....do	Vilmorin's Improved	17	13.5	81.1	
162	.....do	.....do	E. C. Post	.....do	10	11.7	76.9	No.
160	.....do	Steiner	G. Gruber	Zehringen	10	13.1	81.2	No.
153	.....do	Monroe	E. C. Post	Vilmorin's Improved	21	12.6	79.2	No.
152	.....do	.....do	.....do	.....do	30	11.6	75.8	Yes.
150	.....do	.....do	.....do	.....do	29	10.9	74.7	No.
148	.....do	.....do	.....do	.....do	21	14.3	76.1	No.
144	.....do	.....do	.....do	Zehringen	5	14.8	.....	No.
140	.....do	.....do	.....do	Vilmorin's Improved	12	10.6	73.5	No.
138	.....do	.....do	.....do	Zehringen	13	12.4	79.8	No.
134	.....do	.....do	.....do	Vilmorin's Improved	10	14.5	81.4	No.
126	.....do	.....do	.....do	Zehringen	21	12.9	80.5	No.
124	.....do	.....do	.....do	.....do	20	13.3	80.9	No.
121	.....do	.....do	.....do	.....do	18	11.7	76.0	No.
120	.....do	.....do	.....do	.....do	20	10.8	78.1	Yes.
117	.....do	.....do	.....do	Vilmorin's Improved	10	10.0	71.4	No.
116	.....do	.....do	.....do	Zehringen	22	10.7	74.9	No.
111	.....do	.....do	.....do	Vilmorin's Improved	37	11.7	78.9	No.
109	.....do	.....do	.....do	Zehringen	28	10.9	75.7	No.
273	.....do	Strasburg	P. P. Samm	Vilmorin's Improved	18	13.8	83.8	No.
261	.....do	.....do	.....do	.....do	20	11.5	77.1	No.
201	.....do	Monroe	E. C. Post	.....do	20	13.0	77.0	No.
202	.....do	.....do	.....do	Zehringen	20	11.4	77.4	No.
203	.....do	.....do	.....do	Vilmorin's Improved	23	13.3	77.3	No.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	MICHIGAN—continued.							
					Ounces.	*Per cent.*	*Per cent.*	
491	Monroe □	Monroe	J. C. Sterling	Kleinwanzlebener	16	15.6	80.4	Yes.
486	do	do	do	do	35	12.5	76.7	Yes.
472	do	do	W. C. Sterling, jr	do	14	14.7	86.6	No.
447	do	do	E. C. Post	Vilmorin's Improved	30	10.5	76.9	No.
415	do	do	do	Zehringen	16	13.0	79.2	No.
405	do	do	do	Vilmorin's Improved	20	12.2	78.0	No.
516	do	do	do	Zehringen	26	14.6	78.6	No.
526	do	do	do	Vilmorin's Improved	24	12.3	74.6	No.
528	do	do	do	do	44	11.2	72.4	No.
501	do	Steiner	G. Fiedler	Zehringen	56	9.5	70.4	No.
599	do	Monroe	J. C. Sterling	Kleinwanzlebener	59	10.2	74.3	Yes.
593	do	do	do	do	63	12.5	77.9	Yes.
661	do	do	E. C. Post	Vilmorin's Improved	22	12.1	78.4	No.
697	do	do	do	Zehringen	13	12.9	78.2	No.
723	do	do	do	do	27	14.3	83.3	No.
734	do	do	do	Vilmorin's Improved	26	13.6	82.6	No.
743	do	do	do	Zehringen	29	10.3	77.1	No.
750	do	do	do	Vilmorin's Improved	23	12.5	77.6	No.
761	do	do	do	Zehringen	32	13.8	82.8	No.
772	do	do	do	Vilmorin's Improved	20	13.3	81.9	No.
789	do	do	do	do	28	12.7	77.9	No.
793	do	do	do	do	29	12.6	81.1	Medium.
794	do	do	do	Zehringen	14	12.0	79.2	No.
799	do	do	do	do	6	16.0	85.3	No.
797	do	do	do	do	27	14.1	81.8	No.
825	do	do	do	do	22	12.2	73.6	Medium.
832	do	do	do	Vilmorin's Improved	24	14.6	83.2	No.
836	do	do	do	Zehringen	25	13.4	80.6	No.
844	do	do	do	do	26	13.5	79.3	No.
846	do	do	do	Kleinwanzlebener	28	13.1	80.2	No.
819	do	Scofield	G. P. Zink	Vilmorin's Improved	32	13.1	80.7	No.
823	do	Dundee	E. L. Potter	do	37	12.6	81.1	No.
866	do	Steiner	G. Gruber	Zehringen	26	11.9	78.2	No.
984	do	Monroe	E. C. Post	Vilmorin's Improved	25	12.9	77.3	No.
982	do	do	do	do	12	16.0	84.4	No.
954	do	do	F. T. Kiff	Zehringen	23	11.6	71.7	No.
912	do	do	J. Krenchauf	Vilmorin's Improved	16	13.7	81.8	No.
64	Montcalm □	Butternut	E. W. Johnson	Kleinwanzlebener	28	12.5	81.3	Yes.
105	do	Langston	Wm. McHattie	Vilmorin's Improved	26	11.3	71.2	Yes.
431	do	Edmore	C. W. Curtis	do	10	14.1	82.7	Yes.
471	do	Sidney	J. H. Noah		8	14.2	82.8	Yes.
557	do	Langston	Wm. McHattie	Vilmorin's Improved	36	12.7	78.4	Yes.

639	....do	Lakeview	A. B. Dickerson		10	13.8	84.3	No.
652	....do	Vestaburg	J. W. Johnson	Kleinwanzlebener	12	11.2	75.6	No.
737	....do	Edmore	C. W. Curtis		8	14.9	83.5	No.
7	Oakland □	Rochester	C. A. Burr	Kleinwanzlebener	23	10.4	76.7	No.
538	....do	Davisburg	A. G. Gregory		13	10.9	75.6	No.
607	St. Clair □	Marine City	Wm. McNeil	Zehringen	23	13.6	81.3	No.
776	....do	....do	J. Kearns	Kleinwanzlebener	28	13.5	79.8	No.
830	....do	....do	W. F. Sauler	....do	17	12.9	79.1	No.
835	....do	....do	R. B. Baird	....do	29	15.6	87.2	No.
849	....do	....do	O. J. McDonald		32	13.6	76.1	No.
858	....do	....do	A. T. Young	Kleinwanzlebener	19	14.8	88.1	No.
865	....do	....do	....do	....do	23	14.5	81.8	No.
861	....do	....do	....do	Vilmorin's Improved	15	14.5	82.3	No.
867	....do	....do	R. Smith		31	13.3	77.8	No.
891	....do	Algonac	C. F. Folkerts	Kleinwanzlebener	15	13.4	81.0	No.
872	....do	Marine City	J. Bommel, jr	....do	57	12.2	76.2	No.
874	....do	....do	....do	....do	47	10.8	73.1	No.
968	....do	....do	C. O. Smith	....do	25	14.8	81.2	No.
967	....do	....do	....do	....do	36	14.4	80.4	No.
945	....do	....do	E. Daniels	....do	22	14.4	81.7	No.
942	....do	....do	J. Smith	....do	18	14.3	78.1	No.
940	....do	....do	C. Stribing	....do	20	14.8	84.8	No.
963	....do	....do	G. G. Smith	....do	28	12.5	77.0	No.
962	....do	St. Clair	J. McGregan	....do	20	12.5	77.9	No.
961	....do	Marine City	E. A. Stephenson	....do	31	13.9	80.2	No.
957	....do	....do	C. F. Spademan	....do	22	14.4	84.4	No.
969	....do	....do	C. O. Smith	....do	20	15.0	81.9	No.
972	....do	....do	Wm. McNeil	Vilmorin's Improved	22	13.0	77.5	No.
59	Saginaw □	Bridgeport	C. Corby	Kleinwanzlebener	36	12.6	78.3	Yes.
575	Sanilac □	Brown City	J. Gunn		25	12.6	77.7	No.
573	....do	....do	....do	Zehringen	25	11.7	73.6	No.
959	....do	Richmondville	J. McCully		34	15.7	85.0	Yes.
958	....do	....do	J. McCully	Kleinwanzlebener	17	14.4	80.8	Yes.
6	Tuscola □	Caro	H. G. Sherman	Vilmorin's Improved	15	12.1	79.3	No.
14	....do	....do	J. S. Kitchen	Kleinwanzlebener	20	14.0	78.2	No.
92	....do	....do	M. Taylor	Biendorf Élite Kleinwanzlebener	24	11.8	80.5	No.
95	....do	....do	J. Nelson		32	9.7	73.4	No.
63	....do	....do	J. J. Berry		18	14.4	83.0	No.
48	....do	....do	E. Reynolds	Vilmorin's Improved	13	11.6	79.7	No.
55	....do	....do	J. B. Delling	....do	29	12.2	81.0	No.
76	....do	....do	G. Marsaw	Kleinwanzlebener	29	14.4	80.3	No.
71	....do	....do	J. Williams	....do	44	11.1	71.8	Yes.
187	....do	....do	I. N. Taggett	Vilmorin's Improved	16	12.4	75.1	No.
168	....do	....do	N. McComb	Kleinwanzlebener	18	14.3	83.3	No.
149	....do	Millington	C. Strong	....do	12	14.2	87.2	Yes.
102	....do	Caro	H. G. Sherman	Vilmorin's Improved	20	13.1	81.7	No.
133	....do	....do	R. Emery	Kleinwanzlebener	15	13.5	82.5	No.
131	....do	....do	B. L. Ransford	....do	21	12.5	76.7	No.
127	....do	....do	J. C. Gordon	....do	20	12.9	80.5	No.
115	....do	....do	A. C. Berry	....do	7	13.9	81.6	No.
107	....do	....do	J. G. Miller	....do	19	12.8	80.0	No.
257	....do	....do	D. Haist	....do	18	13.7	81.8	No.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	MICHIGAN—continued.				*Ounces.*	*Per cent.*	*Per cent.*	
259	Tuscola	Caro	St. Mercer	Kleinwanzlebener	8	14.1	.....	No.
263	do	do	do	do	8	9.6	.....	No.
266	do	do	A. H. Andrews	Vilmorin's Improved	16	15.0	85.9	No.
268	do	do	F. Lester		30	12.6	78.5	No.
401	do	do	S. K. Griffin	Kleinwanzlebener	15	14.7	84.7	No.
400	do	do	do	do	21	14.6	84.6	No.
434	do	do	J. S. Kitchen	do	19	15.2	83.8	No.
505	do	do	I. Hamo		13	11.6	75.8	No.
518	do	Ellington	E. Rogers	Kleinwanzlebener	21	12.1	76.9	No.
531	do	Caro	E. Reynolds	Vilmorin's Improved	21	13.1	83.6	No.
554	do	do	A. J. Dale	do	12	14.7	82.5	No.
642	do	East Dayton	G. Froed	do	16	14.1	80.4	No.
641	do	Ellington	C. Wickware	Kleinwanzlebener	16	16.6	87.5	No.
677	do	Caro	Mrs. E. M. Darbee		11	14.8	82.5	No.
727	do	do	C. Hooper	Vilmorin's Improved	16	14.5	80.9	No.
740	do	do	J. B. Delling	do	28	12.5	81.5	No.
785	do	do	J. N. Botsford	Kleinwanzlebener	12	14.1	83.6	No.
802	do	do	J. G. Miller	do	19	14.4	89.9	No.
818	do	do	F. Slocum		9	15.4	84.8	No.
878	do	do	F. Lester		12	13.3	82.3	No.
919	do	do	J. C. Gordon	Kleinwanzlebener	11	14.4	83.0	No.
974	do	do	J. Williams	do	37	9.2	65.9	No.
953	Van Buren	Kendall	C. M. Kingsley	Imperial Elite	18	12.7	82.7	No.
57	Wayne	Detroit	Mrs. E. K. Sellack	Kleinwanzlebener	19	10.3	74.0	Yes.
49	Wexford	Benson	J. Bell	do	29	12.6	81.1	No.
683	do	do	do	do	28	14.1	83.6	No.
	State averages (236 samples).				22	13.1	79.7	
	MINNESOTA.							
332	Chippewa	Montevideo	J. Stewart		32	10.4	74.1	No.
584	Dakota	Hastings	M. G. Le Duc	Kleinwanzlebener	10	12.5	80.5	No.
185	Martin	Welcome	D. Hulseman	do	30	9.9	72.7	No.
608	Polk	Fisher	C. Flaiskey		43	12.5	74.8	No.
30	Scott	Belleplaine	N. P. Lindberg	Kleinwanzlebener	23	14.4	80.8	No.
31	do	do	do	do	22	14.0	79.0	No.
572	do	do	do		10	12.7	80.7	No.
788	Stearns	St. Cloud	F. Wesenberg	Kleinwanzlebener	12	13.3	79.1	No.

65	Wabasha	Lake City	J. A. Jackson		26	10.8	75.5	Yes.
	State averages (9 samples).				23	12.3	77.5	
	MISSOURI.							
460	Barton	Verdella	A. Wolf	Kleinwanzlebener	8	9.1	63.6	No.
464	do	do	do	do	6	9.0	65.1	No.
913	do	Lamar	J. S. Terhune	do	16	7.6	59.7	No.
927	do	do	R. R. Selvey	do	10	5.2	51.9	No.
929	do	do	William Craig	do	7	5.4	52.3	No.
937	do	Iantha	H. A. Emers	do	13	5.7	58.9	
806	do	Liberal	P. D. Ridenour	do	28	12.2	73.1	
146	Camden	Stoutland	G. M. Sisk		13	7.0		Yes.
147	do	do	do		12			Yes.
54	Carroll	Mandeville	Wm. Wilson	Vilmorin's Improved	7	10.2	77.5	No.
40	Cass	Creighton	M. Dale		14	8.4	65.2	No.
302	Iron	Ironton	C. S. Russell		16	8.0	76.5	Yes.
18	Jefferson	Desoto	J. F. G. Herger	Kleinwanzlebener	23	7.3	77.7	Yes.
19	do	do	do	do	24	6.6	62.0	Yes.
86	Pettis	Houstonia	S. J. Spurgeon	Vilmorin's Improved	39	5.7	56.1	Yes.
625	Pulaski	Hancock	J. Staben		29	6.8	64.8	Yes.
110	Ste. Genevieve	Kinsey	F. Hoover		9	10.5	71.4	No.
58	Shelby	Shelbina	J. S. Chandler	Vilmorin's Improved	44	6.0	54.3	No.
26	Wayne	Zeitona	O. C. Lucy		6	7.2	62.8	Yes.
	State averages (19 samples).				17	7.1	64.3	
	MONTANA.							
51	Yellowstone	Billings	I. D. O'Donnell		40	10.6	73.5	Yes.
364	do	do	do	Vilmorin's Improved	40	10.7	67.7	Yes.
	State averages (2 samples).				40	10.7	70.6	
	NEBRASKA.							
330	Douglas	Millard	A. Faust		17	10.2	70.4	Yes.
331	do	do	W. A. Welch		22	8.3	64.4	Yes.
738	do	do	do		22	12.2	79.0	Yes.
12	Gosper	Bertrand	W. W. Lewis	Vilmorin's Improved	19	10.2	68.1	No.
300	do	do	do	Biendorf Elite Kleinwanzlebener	16	14.6	84.6	No.
101	Saline	Crete	H. Nave	Kleinwanzlebener	16	12.3	80.1	No.
	State averages (6 samples).				19	11.3	74.4	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	NEVADA.				*Ounces.*	*Per cent.*	*Per cent.*	
422	Humboldt □	Lovelocks	J. Harrison	Vilmorin's Improved	27	16.8	85.9	
423	do	do	do	do	12	19.5	84.4	
492	do	do	do	Zehringen	15	16.5	78.3.	
493	do	do	do	do	12	14.1	74.7	
494	do	do	do	do	24	14.4	79.6	
495	do	do	do	do	13	15.4	81.0	
496	do	do	do	do	14	17.9	84.6	
497	do	do	do	do	16	14.2	76.4	
646	do	do	do	do	6	21.1	.....	
950	do	do	do	Vilmorin's Improved	18	16.3	82.6	Yes.
991	do	do	George Young	do	14	16.7	84.6	Yes.
709	Washoe □	Reno	H. F. Dangberg	Zehringen	30	14.5	78.9	
721	do	do	do	do	24	17.3	88.8	
720	do	do	do	do	16	16.7	84.6	
717	do	do	do	do	10	18.8	85.3	
718	do	do	do	do	11	17.7	83.7	
719	do	do	do	do	11	16.9	77.9	
716	do	do	do	do	12	18.0	82.2	
715	do	do	do	do	21	17.1	81.4	
714	do	do	do	do	16	18.7	82.3	
713	do	do	do	do	28	15.1	79.9	
712	do	do	do	do	26	18.1	86.3	
711	do	do	do	do	32	17.8	83.4	
710	do	do	do	do	19	16.8	84.2	
	State averages (24 samples).				18	16.9	82.2	
	NEW HAMPSHIRE.							
247	Cheshire □	Nelson	T. W. Barker	Kleinwanzlebener	15	15.7	83.8	No.
610	do	do	do	do	12	15.0	89.3	No.
760	Rockingham □	Auburn	C. J. Esty	do	18	14.8	84.8	Yes.
755	do	do	do	do	21	16.3	86.1	Yes.
	State averages (4 samples).				17	15.5	86.0	
	NEW JERSEY.							
299	Burlington □	Moorestown	J. D. Pancoast	Kleinwanzlebener	28	9.1	71.6	Yes.
22	Cumberland □	Rosenhayn	J. A. Williams	do	14	9.3	72.6	No.

442	....do	....do	....do	....do	13	12.7	80.2	No.
916	....do	Shiloh	W. S. Bonham	....do	29	10.3	77.1	No.
660	Essex ◻	East Orange	M. P. Willett	Vilmorin's Improved	21	11.4	78.9	Yes.
657	....do	....do	....do	....do	15	11.4	80.5	
651	....do	....do	....do	Kleinwanzlebener	20	9.8	79.3	Yes.
648	....do	....do	....do		22	11.3	79.4	No.
842	Hunterdon ◺	Ludlow	J. A. Hulsizer	Kleinwanzlebener	24	11.1	77.0	No.
887	Mercer ◻	Hightstown	T. L. Hermance	....do	44	14.2	83.2	Yes.
883	....do	....do	....do	....do	56	10 7	74.9	Yes.
706	Monmouth ◻	Matawan	C. M. White	....do	19	13.3	84.3	Yes.
944	....do	New Sharon	F. P. Weitherill	Vilmorin's Improved	16	12.0	82.9	No.
921	....do	Allentown	G. W. Hulse		20	13.6	86.2	No.
663	Warren ◺	Marksboro	F. L. Barton	Vilmorin's Improved	35	8.6	55.5	No.
863	....do	Asbury	G. W. Alpaugh		28	11.9	74.5	No.
808	....do	....do	J. J. Riddle		50	10.9	76.2	No.
	State averages (17 samples).				27	11.3	77.3	
	NEW MEXICO.							
392	Mora ◸	La Cueva	La Cueva Ranch Company	Kleinwanzlebener	18	14.7	82.5	No.
395	....do	....do	....do	....do	26	15.1	83.3	No.
	State averages (2 samples).				22	14.9	82.9	
	NEW YORK.							
857	Broome ◻	Port Dickinson	C. H. Wells	Kleinwanzlebener	9	15.4	86.2	No.
141	Cattaraugus ◻	South Dayton	A. F. Kelly	....do	14	13.5	81.1	No.
563	....do	....do	C. F. Wiegland	Vilmorin's Improved	14	11.8	78.0	No.
752	....do	....do	J. L. Palmer	....do	33	13.0	79.2	Yes.
764	....do	....do	....do	....do	30	12.0	78.2	Yes.
210	Chautauqua ◻	Silver Creek	H. W. Blanding		10	13.1	79.3	No.
313	....do	Fredonia	B. F. Simons	Kleinwanzlebener	12	13.2	84.8	No.
383	....do	Havilah	H. Shultz	....do	42	13.9	89.6	No.
314	....do	Sherman	J. D. Hull	....do	13	14.0	81.2	Yes.
386	....do	Havilah	H. Shultz	....do	26	12.6	83.1	No.
384	....do	Brocton	H. W. Pettit	....do	14	12.0	79.2	No.
561	....do	Fredonia	B. F. Simons	Vilmorin's Improved	9	11.5	75.7	No.
590	.... do	Westfield	F. G. Scott	Kleinwanzlebener	29	12.0	78.8	No.
704	....do	Forestville	E. L. Horton		23	13.2	76.4	No.
758	....do	Fredonia	W. H. Van Scoter	Kleinwanzlebener	13	15.0	85.9	No.
791	....do	Dunkirk	F. Werle	....do	34	13.7	77.4	No.
834	.. ..do	Forestville	U. W. Meade		22	15.6	84.5	No.
915	....do	Silver Creek	W. H. Jacobs	Kleinwanzlebener	13	11.2	76.6	No.
925	. ...do	Smiths Mills	A. Much	Vilmorin's Improved	21	11.8	77.5	No.
936	....do	....do	....do	Kleinwanzlebener	18	13.3	80.5	
564	Columbia ◻	Hudson	C. A. Van Hassen	Vilmorin's Improved	24	12.6	79.7	Yes
348	Erie ◻	Farnham	F. Brinkman	....do	8	12.8	82.8	No.
871	....do	Fenton	C. M. Fenton	Kleinwanzlebener	24	14.0	81.7	No.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1889, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	NEW YORK—continued.				*Ounces.*	*Per cent.*	*Per cent.*	
966	Erie ◻	Buffalo	Buffalo Beet Sugar Company		17	12.8	74.1	No.
255	Franklin ◻	Malone	R. H. Todd	Vilmorin's Improved	36	10.7	71.5	No.
768	Genesee ◻	Le Roy	G. N. Ward	Kleinwanzlebener	22	13.9	89.6	No.
199	Jefferson ◻	Black River	J. W. Fisher	do	22	13.8	81.5	No.
197	do	Alexandria Bay	J. Parker	do	14	13.8	79.7	No.
188	do	Threemile Bay	J. M. Wilcox	do	7	15.0	82.7	No.
179	do	Natural Bridge	M. Fargo	do	10	12.2	76.6	No.
178	do	Depauville	A. S. Grand, jr	do	18	11.1	71.1	No.
166	do	Perch River	H. C. Banks	do	11	12.0	79.2	No.
222	do	St. Lawrence	C. B. Carey		17	11.3	71.2	No.
235	do	Clayton	B. G. Whitney		20	14.0	80.3	No.
241	do	Depauville	D. Weaver		25	11.7	74.5	No.
245	do	Chaumont	C. Gouseth	Kleinwanzlebener	24	14.1	80.4	No.
251	do	St. Lawrence	J. Knapp		10	12.5	77.5	No.
359	do	Clayton	J. Gray	Kleinwanzlebener	33	12.5	76.7	No.
366	do	Threemile Bay	G. H. Herrick		16	13.1	79.8	No.
334	do	do	B. W. Hentze	Kleinwanzlebener	20	12.5	79.0	No.
310	do	Great Bend	E. J. Pennock		21	14.2	79.7	No.
398	do	Chaumont	C. J. Fisher	Zehringen	15	14.2	80.1	No.
376	do	Great Bend	E. F. Peck		30	12.7	78.4	No
381	do	Natural Bridge	R. Fluno	Kleinwanzlebener	8	13.4	77.0	No.
382	do	Point Peninsula	C. A. Collins		19	14.5	82.3	No.
485	do	Natural Bridge	J. W. Nichols	Kleinwanzlebener	21	9.7	62.5	No.
444	do	Point Peninsula	B. Harris		23	11.4	75.9	No.
432	do	Riverview	A. Weaver		19	11.7	75.0	No.
463	do	Carthage	De Vere R. Vrooman		21	13.1	77.5	No.
470	do	Chaumont	J. F. George	Kleinwanzlebener	14	12.2	70.6	No.
475	do	Clayton	P. McKinley	do	12	12.9	78.2	No.
414	do	Watertown	P. O'Brien	do	21	11.9	78.2	No.
411	do	St. Lawrence	W. E. Watrath	do	36	10.3	71.5	No.
403	do	Watertown	G. L. Gardner		22	11.1	75.5	No.
504	do	Natural Bridge	W. Porriga	Kleinwanzlebener	19	13.5	77.6	No.
544	do	Clayton	J. Barrett	do	29	11.9	76.6	
592	do	Natural Bridge	M. A. Samson	do	18	11.4	74.1	No.
596	do	Chaumont	M. Calkins	Vilmorin's Improved	4	11.0	76.3	No.
602	do	Dexter	W. Livermore	Kleinwanzlebener	12	12.0	75.9	No.
605	do	Threemile Bay	G. Chapman	do	13	10.6	76.2	No.
606	do	do	do	Vilmorin's Improved	23	12.0	80.3	Yes.
612	do	St. Lawrence	T. Emery	French Very Rich	22	12.5	81.4	No.
614	do	Clayton	N. B. Hill	do	13	15.5	81.5	No.
615	do	do	do		11	15.8	86.5	No.

621	do	Chaumont	L. Brown	Kleinwanzlebener	12	12.5	78.1	No.
628	do	Ellisburg	D. C. Woodruff	do	16	12.5	80.0	No.
676	do	Depauville	D. Weaver		30	11.4	75.0	No.
685	do	St. Lawrence	G. F. Comins	Kleinwanzlebener	8	11.3	78.8	No.
689	do	Theresa	A. Cooper	do	10	12.7	77.5	No.
725	do	Carthage	C. D. Dawley	do	12	14.9	84.4	No.
732	do	Threemile Bay	G. H. Herrick		26	13.4	80.6	No.
735	do	Alexandria Bay	J. F. Parker	Kleinwanzlebener	22	13.7	78.3	No.
741	do	Limerick	L. Weaver		17	12.1	79.9	No.
746	do	Philadelphia	I. Scoutin		17	13.5	80.7	No.
757	do	Natural Bridge	R. Tooker	Kleinwanzlebener	14	10.3	70.6	No.
759	do	Chaumont	H. E. Horton	do	26	13.1	77.5	No.
766	do	Pillar Point	F. Hancock	Zehringen	7	13.7	80.0	No.
790	do	Carthage	W. F. Dening		11	14.8	85.2	No.
843	do	do	Wm. P. Ford	Kleinwanzlebener	12	15.0	83.2	No.
841	do	Chaumont	L. Brown	do	12	14.8	84.3	No.
828	do	St. Lawrence	C. B. Buckminster	Vilmorin's Improved	15	13.7	83.2	No.
827	do	Carthage	O. Foley	Kleinwanzlebener	3			
855	do	Chaumont	E. Gibbon		19	11.2	72.8	No.
949	do	Adams	G. E. Clark	French Very Rich	20	15.5	84,0	No.
920	do	do	F. A. Stone	do	18	14.1	83.1	No.
917	do	Riverview	Q. A. Beadle	Kleinwanzlebener	8	12.2	78.0	No.
902	do	Sacket Harbor	G. Brown	do	31	12.7	76.6	No.
901	do	Adams	A. B. Huron	French Very Rich	20	12.7	73.2	No.
997	do	Champion	O. Fletcher	Mangold	7	11.7	75.0	No.
198	Lewis ⊡	Port Leyden	W. D. Rousam		14	14.8	82.1	No.
265	do	Pinckney	G. E. Lane	Vilmorin's Improved	15	14.7	82.0	No.
421	do	Kirschnerville	F. Ritz	Kleinwanzlebener	23	12.1	74.3	No.
552	do	Croghan	J. Wolff	Vilmorin's Improved	16	12.5	76.6	No.
553	do	do	J. N. Bintz	Kleinwanzlebener	14	12.7	77.9	No.
568	do	do	J. Lyndaker		11	14.3	82.9	No.
570	do	do	A. C. Perkins	Vilmorin's Improved	32	14.6	82.8	No.
643	do	Lowville	J. N. Pelton	Kleinwanzlebener	16	11.0	73.4	No.
673	do	Harrisville	C. Maynard	do	34	11.6	78.7	No.
692	do	Deer River	O. F. Werner		31	11.5	73.4	No.
693	do	do	do		22	11.2	72.0	No.
262	Livingston ⊡	Dansville	A. Carey	Kleinwanzlebener	28	13.4	80.1	No.
308	Oneida □	Paris	G. B. Smith	do	14	14.5	80.5	No.
304	Onondaga □	Baldwinsville	C. Bradley	do	16	14.6	86.0	No.
307	do	do	G. Meigs	do	15	14.2	82.3	No.
436	do	do	L. Bolger		11	10.8	74.5	No.
429	do	East Syracuse	A. C. Bethka	Vilmorin's Improved	21	12.3	74.5	No.
851	do	Baldwinsville	C. Bradley	Kleinwanzlebener	14	15.2	83.8	No.
870	do	do	G. Meigs	do	16	14.0	83.0	No.
880	Orange □	Circleville	J. Terry	do	29	12.5	79.0	No.
879	do	do	D. Ayres	do	29	13.3	77.3	No.
860	Orleans ⊡	Fancher	H. O. Hakes	do	35	10.5	74.3	No.
439	Oswego □	Lacona	F. D. Elmer	do	20	14.6	83.7	No.
517	do	Texas	J. C. Farr	do	11	13.5	79.3	No.
637	do	Prattham	L. M. Parmeter	Kleinwanzlebener	23	13.4	77.0	No.
754	do	Fulton	W. S. Nelson		6	16.0	84.8	No.
234	Otsego □	Morris	Rev. G. P. Turnbul	Kleinwanzlebener	20	14.0	83.0	Yes.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	NEW YORK—continued.				*Ounces.*	*Per cent.*	*Per cent.*	
125	Rensselaer □	Eagle Bridge	C. H. Young	Kleinwanzlebener	34	12.4	81.8	No.
624	....do	East Greenbush	Finnerty Bros	....do	21	10.8	73.5	No.
634	....do	....do	....do	....do	13	12.1	77.5	No.
363	St. Lawrence □	Ogdensburg	A. E. Southwick	....do	19	12.8	74.5	Yes.
353	....do	Rackett Bridge	J. St. Thomas	....do	38	12.5	78.5	No.
312	....do	Norfolk	Wm. Borrman	....do	12	12.7	80.2	No.
311	....do	Canton	G. McCoy	....do	20	14.5	83.2	No.
461	....do	Lawrenceville	C. Frary	....do	16	9.8	56.9	No.
402	....do	Madrid	J. N. Hughes	....do	30	13.6	80.8	No.
511	....do	Hailesboro	C. A. Carpenter	....do	21	13.9	80.2	No.
513	....do	Buckton	B. A. Meacham	French Very Rich	15	14.2	82.8	No.
514	....do	Fort Jackson	F. N. Kellogg	....do	24	14.8	83.0	No.
530	....do	Hailesboro	C. A. Carpenter	Zehringen	22	13.3	78.2	No.
620	....do	Crary Mills	M. S. Wallace		14	14.2	82.3	No.
622	....do	Gouverneur	B. J. Morris	Kleinwanzlebener	24	12.5	78.1	No.
627	....do	Ogdensburg	D. E. Southrick	....do	22	14.6	85.5	No.
682	....do	De Kalb Junction	C. A. Hallegas		30	11.6	73.9	No.
303	Saratoga □	Schuylerville	J. H. Bullard	Zehringen	12	13.0	78.3	No.
595	....do	....do	....do	....do	17	11.3	73.5	Yes.
635	Seneca □	Waterloo	Miss N. L. Utzman	Kleinwanzlebener	39	12.5	79.0	No.
212	Steuben □	Atlanta	N. Rellis	Vilmorin's Improved	12	12.6	76.0	No.
523	....do	Adrian	F. E. Hush	Kleinwanzlebener	12	14.4	82.5	No.
684	Tompkins □	Ithaca	L. A. Clinton	Zehringen	17	15.8	86.0	No.
686	....do	....do	....do	....do	14	14.6	83.7	No.
246	Wayne □	Macedon Center	M. E. Pulver	Kleinwanzlebener	32	14.7	79.1	No.
274	....do	....do	....do	....do	31	14.1	77.9	No.
	State averages (142 samples).				19	13.0	78.8	
	NORTH CAROLINA.							
180	Ashe □	Roberts	W. J. Roberts	Vilmorin's Improved	6			
854	Rowan □	Salisbury	E. L. Hulig	....do	28	7.6	69.0	No.
	State averages (2 samples).				17	7.6	69.0	
	NORTH DAKOTA.							
375	McHenry □	Anamoose	J. O. Horsky	Zehringen	23	12.5	80.5	No.
267	Steele □	Colgate	I. H. Brepke	Danish Improved	20	15.4	77.5	No.

253	....do	....do	....do	.... do	22	13.7	77.0	No.
	State averages (3 samples).				22	13.9	78.3	
	OHIO.							
724	Ashtabula	Rock Creek	H. H. Schoville	Zehringen	16	6.6	59.5	No.
731	....do	....do	....do	Kleinwanzlebener	17	10.9	75.7	No.
406	Auglaize	Wapakoneta	I. J. Gehrlich	....do	27	12.2	78.0	Yes.
412	....do	....do	....do	Vilmorin's Improved	25	13.0	77.9	Yes.
385	Belmont	Key	Robt. McKelvey		6	14.1	81.3	No.
993	Brown	Fayetteville	L. A. Sourd	Kleinwanzlebener	20	10.8	69.1	No.
242	Champaign	Millerstown	J. J. McIntire		11	14.0	75.3	No.
417	....do	Mechanicsburg	H. C. Rogers		9	10.6	72.7	No.
416	....do	....do	....do		12	9.9	71.7	No.
445	Clark	North Hampton	G. Grieser		27	11.2	76.6	No.
450	....do	....do	....do		35	7.4	62.9	No.
603	....do	Osborn	G. Kendig	Vilmorin's Improved	17	10.6	70.3	No.
775	....do	Springfield	G. H. Byen	Kleinwanzlebener	47	8.7	67.6	No.
965	....do	Enon	D. Baker		8	11.7	77.4	No.
357	Columbiana	Salineville	F. M. Bosing	Kleinwanzlebener	12	14.8	80.0	No.
512	Coshocton	Nellie	J. P. Darling	....do	12	9.7	73.4	Yes.
462	Crawford	Bucyrus	J. N. Krauter	Vilmorin's Improved	21	9.6	66.5	No.
458	....do	....do	....do	Mangold	18	8.6	67.2	
457	....do	....do	....do	Kleinwanzlebener	23	10.7	69.3	
456	....do	....do	....do	Vilmorin's Improved	28	10.7	69.3	
769	....do	Galion	J. H. Cook		20	12.4	77.4	Yes.
424	Erie	Berlin Heights	A. Campbell	Kleinwanzlebener	25	13.8	83.3	No.
533	....do	Vermilion	C. Kuehlman	....do	17	14.8	80.4	Yes.
577	....do	Berlin Heights	A. Campbell	....do	17	14.1	82.7	No.
781	....do	Vermilion	R. Darby	....do	35	12.5	78.1	Yes.
869	....do	Castalia	F. Ortner	....do	34	10.2	70.9	No.
340	Fayette	Madison Mills	E. A. Parrott	....do	24	9.8	63.9	No.
453	Franklin	Alton	N. Wilhelm	....do	30	11.8	76.5	No.
928	....do	Pleasant Corners	S. Taylor		21	10.1	68.8	No.
931	....do	....do	....do		22	11.9	74.9	No.
196	Fulton	Delta	F. S. Wolcott	Kleinwanzlebener	23	9.3	76.6	No.
195	....do	....do	....do	Zehringen	20	12.0	80.3	No.
549	Geauga	Chardon	L. E. Doup	Vilmorin's Improved	32	11.1	72.7	No.
176	Greene	Spring valley	J. D. Mills	Kleinwanzlebener	17	10.0	73.4	No.
189	....do	Xenia	E. S. Foust	Zehringen	28	12.6	75.6	No.
371	....do	Jamestown	O. M. Conner	Kleinwanzlebener	22	10.2	70.4	Yes.
378	....do	Osborn	F. Nalterlin	....do	7	14.5	83.6	No.
765	....do	Fairfield	J. Schoenkerr	....do	12	10.1	72.1	Yes.
782	....do	Osborn	J. H. Copenheffer	Vilmorin's Improved	23	13.3	79.5	No.
535	Knox	Howard	A. Blue	Kleinwangzlebener	20	11.3	76.8	No.
339	Lake	Willoughby	L. J. Fenner	....do	32	11.8	78.0	No.
795	....do	Madison	A. Whipple	.... do	18	14.1	83.6	No.
956	....do	North Madison	J. Tawney	Zehringen	23	15.0	83.6	No.
534	Logan	West Liberty	J. G. Hewlings	Vilmorin's Improved	18	12.6	78.7	No.
567	Lorain	Elyria	L. G. Hamilton	Zehringen	23	12.2	77.1	No.

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	OHIO—continued.				*Ounces.*	*Per cent.*	*Per cent.*	
751	Lorain ⊔	Elyria	L. G. Houston	Kleinwanzlebener	25	12.7	79.3	No.
694	Lucas □	Fancher	G. C. Betts	do	17	12.0	80.3	Yes.
701	do	Toledo	P. D. Kuntz	do	36	12.0	77.8	No.
995	do	Whitehouse	Y. Rakestian	Vilmorin's Improved	15	12.9	85.0	No.
990	do	do	do	do	19	13.2	80.8	No.
454	Madison □	Chenoweth	W. T. Carmon	Kleinwanzlebener	33	12.2	70.2	No.
930	Marion □	Marion	S. Bolander	do	22	10.5	72.4	No.
413	Mercer ⊔	Carthagena	H. Dalinghaus	do	18	12.5	74.1	No.
691	do	St. Rosa	J. Stucke	do	19	10.1	68.8	No.
705	do	do	do	do	17	11.1	71.7	No.
708	do	Celina	J. Hess	do	12	12.2	79.0	No.
973	do	Montezuma	H. B. Bennett		12	12.5	80.0	No.
390	Miami ⊔	Tippecanoe City	William W. Crane	Kleinwanzlebener	15	9.5	70.9	No.
420	do	Lena	J. J. Merritt	do	14	13.1	77.5	No.
216	do	Fidelity	C. C. Neal	Zehringen	13	9.3	76.6	No.
733	do	Tippecanoe City	William W. Crane	Kleinwanzlebener	19	12.8	80.9	No.
89	Montgomery ⊔	Dayton	C. L. Gerlaugh		14	12.6	78.7	
88	do	do	do	Vilmorin's Improved	9	13.6	78.2	
87	do	do	do		13	12.6	78.3	
315	do	Trotwood	M. Denlinger	Vilmorin's Improved	14	13.5	80.2	Yes.
316	do	do	J. G. Kuns	do	22	10.9	74.2	Yes.
487	do	do	J. Denlinger	do	9	12.7	77.9	Yes.
483	do	do	do	do	19	11.2		Yes.
473	do	Dayton	R. R. Dickey, jr	Mangold	13	12.4	76.9	Yes.
589	do	do	F. Shank	Vilmorin's Improved	23	12.3	81.7	No.
664	do	Englewood	S. W. Coble	Kleinwanzlebener	13	10.6	73.0	No.
665	do	do	do	do	17	11.2	73.8	No.
726	do	Trotwood	J. G. Kuns	do	14	13.4	80.6	Yes.
784	do	Dayton	J. Boughnecht		17	14.4	84.4	No.
194	Muskingum □	Fultonham	D. H. Coleman	Kleinwanzlebener	16	11.7	76.0	No.
213	Noble ⊔	Rich Valley	F. A. Flourance	do	21	9.5	72.5	No.
433	do	Sarahsville	J. A. Craft		19	8.9	70.1	Yes.
173	Ottawa ⊔	Rockyridge	W. W. Whitten	Kleinwanzlebener	40	12.7	77.9	No.
372	do	do	F. Kardatzke		34	14.4	81.6	No.
410	do	Oakharbor	H. Shubert		25	13.7	79.6	
579	do	Danbury	J. Wohlers		23	13.9	80.7	Yes.
506	do	Oakharbor	L. Seelig	Kleinwanzlebener	14	12.6	77.4	Yes.
507	do	Rockyridge	F. Greening		38	11.8	74.3	No.
668	do	Oakharbor	M. L. Seelig	Kleinwanzlebener	13	14.3	79.8	Yes.
771	do	do	F. Klug		35	15.0	84.9	
787	do	do	A. Apling	Kleinwanzlebener	46	11.6	76.7	Yes.
875	do	do	A. Kline		37	11.8	70.1	No.

805	do	Trowbridge	G. Base		15	11.9	74.9	No.
923	do	Oakharbor	C. Vollm	Kleinwanzlebener	33	11.8	75.6	Yes.
922	do	do	H. Below	do	34	12.9	79.1	Yes.
154	Paulding □	Payne	J. Wobles		25	12.0	77.8	
240	do	Paulding	J. W. Kunkleman	Kleinwanzlebener	18	14.0	83.0	Medium.
437	do	Payne	J. J. Stout	do	37	11.0	73.4	Yes.
440	do	do	do	do	38	10.7	70.2	Yes.
467	do	do	J. Bainbridge		35	9.7	68.0	Yes.
707	do	Paulding	J. W. Kunkleman	Kleinwanzlebener	29	12.2	79.0	Medium.
749	do	Payne	J. Beque		92	11.3	76.8	Medium.
594	Perry □	Thornville	Mrs. B. Alspach	Kleinwanzlebener	48	8.6	68.2	No.
598	do	do	do	Vilmorin's Improved	20	9.9	75.4	No.
269	Portage ◻	Garrettsville	A. A. Walton	Kleinwanzlebener	23	14.0	82.1	No.
309	do	Nelson	M. C. Sweet	do	16	12.5	76.2	No.
524	do	do	do	do	24	13.7	80.4	No.
662	Sandusky □	Teemes	Don. Martin		33	13.9	83.4	Yes.
783	do	do	H. Prentice	Vilmorin's Improved	21	13.0	77.9	No.
264	Seneca □	Kansas	J. Depinet		23	11.4	77.9	Yes.
623	do	Fostoria	T. B. Hartley	Kleinwanzlebener	21	11.3	74.9	No.
896	do	do	F. Gebert	do	37	14.3	77.3	
895	do	do	do	do	44	12.0	74.6	
888	do	do	C. E. Palmer	do	34	12.7	76.1	
884	do	do	do	do	38	13.3	80.5	
578	Summit ◻	Ira	C. O. Hale	do	32	11.2	77.6	Yes.
671	do	do	E. F. Cranz	Biendorf Elite Kleinwanzlebener	16	9.7	71.8	Yes.
588	Van Wert □	Cavett	J. W. Jenkins	Kleinwanzlebener	24	11.3	76.7	Yes.
976	do	Van Wert	C. H. Hymen	Vilmorin's Improved	44	10.6	76.2	No.
700	Vinton □	Hamden Junction	J. Newman	do	25	12.7	78.4	No.
377	Wayne □	Smithville	J. E. Zimmerman	Kleinwanzlebener	11	13.0	77.9	No.
394	do	Creston	I. W. Knesteiels	do	32	14.4	82.2	No.
629	do	Smithville	Mrs. B. Zimmerman	do	17	10.6	73.2	No.
645	do	Springville	R. Eason	do	12	11.5	73.8	No.
250	Wood □	Sugar Ridge	F. Tietjen		51	12.4	82.8	Yes.
272	do	do	J. D. Smith	Kleinmanzlebener	29	12.5	79.2	No.
347	do	Dunbridge	F. Rogers	do	29	12.0	76.4	No.
338	do	Lime City	G. Benck		41	10.9	73.3	No.
346	do	Dunbridge	F. Rogers	Kleinmanzlebener	38	12.2	74.9	No.
341	do	Bowling Green	N. Buchman	do	13	16.9	81.2	No.
408	do	do	S. C. Dimick	Vilmorin's Improved	22	11.2	74.7	Yes.
490	do	Sugar Ridge	J. D. Smith	Kleinwanzlebener	20	12.5	77.5	No.
667	do	Bowling Green	Mrs. M. E. Edwards		36	10.7	72.9	Yes.
	State averages (128 samples).				24	11.9	76.1	
	OKLAHOMA.							
231	Cleveland □	Norman	P. C. Lessly	Kleinwanzlebener	36	12.3	73.7	No.
301	Woods □	Prudence	G. W. Cotton	do	26	8.3	64.9	No.
	State averages (2 samples).				31	10.3	69.3	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	OREGON.				*Ounces.*	*Per cent.*	*Per cent.*	
525	Union	Island City	J. L. Cavings	Kleinwanzlebener	17	15.8	84.3	No.
	State averages (1 sample).				17	15.8	84.3	
	PENNSYLVANIA.							
468	Adams	Littlestown	J. E. Shoemaker	Kleinwanzlebener	32	10.8	75.5	Yes.
465	do	do	do	do	35	8.2	69.9	Yes.
96	Allegheny	Lancelot	J. Hasnour	do	25	10.3	68.8	Yes.
373	Beaver	Cannelton	J. S. Elder	Biendorf Elite Kleinwanzlebener	34	9.9	74.3	Yes.
380	do	do	do	do	18	9.7	73.4	Yes.
669	Berks	Daubervillo	J. L. Loos		30	13.4	80.6	Yes.
678	do	do	do		41	14.3	84.3	Medium.
387	Bucks	Zion Hill	J. M. Krauss		40	11.6	78.7	Yes.
520	do	Plumsteadville	A. Landes	Mangold	21	11.8	78.5	Yes.
510	do	do	do	do	19	11.3	77.3	Yes.
655	do	Zion Hill	J. M. Krauss	do	30	12.9	80.0	Yes.
649	Chester	Loag	P. W. Nagle	Kleinwanzlebener	52	7.8	67.2	Yes.
232	Clarion	Kingsville	D. O. Kerr	do	17	11.4	78.4	Yes.
853	do	do	do		21	11.8	81.6	Yes.
352	Erie	Erie	D. Schlosser	Kleinwanzlebener	65	13.0	85.1	No.
351	do	do	do	Biendorf Elite Kleinwanzlebener	40	10.6	64.1	No.
350	do	do	do	Zehringen	21	11.2	74.2	No.
349	do	do	do	Kleinwanzlebener	68	11.8	76.1	No.
404	do	Fairplain	C. Zeisenheim	do	31	10.6	76.1	No.
900	do	Philipsville	E. E. Titus	do	21	11.8	75.6	No.
205	Jefferson	Reynoldsville	N. Syphrit		24	12.6	70.0	Yes.
211	Montgomery	Narcissa	T. J. Bulcher	Vilmorin's Improved	16	12.3	79.2	Yes.
672	do	Colmar	Miss N. Dates	Mangold	11	9.7	69.0	No.
744	do	Threeturns	Wm. Atkinson	Kleinwanzlebener	47	10.8	78.6	Yes.
1000	do	Glenside	W. W. Harrison	Vilmorin's Improved	41	11.2	74.7	Yes.
137	Northumberland	Dewart	R. N. Nicely		14	10.3	74.0	Yes.
992	do	Watsontown	F. S. Derr		17	12.2	76.2	Yes.
123	Snyder	Beavertown	M. E. Hoffman	Vilmorin's Improved	28	9.6	69.7	No.
	State averages (28 samples).				31	11.2	75.4	
	SOUTH CAROLINA.							
39	Greenville	Chicks Springs	J. D. Howell	Kleinwanzlebener	16	9.5	68.0	No.
591	do	do	do	do	13	13.3	82.3	No.

998	....do	....do	....do	....do	11	14.1	84.6	No.
981	....do	....do	....do	....do	14	15.0	82.3	No.
	State averages (4 samples).				14	13.0	79.3	
	SOUTH DAKOTA.							
537	Beadle	Huron	N. T. Smith		25	7.8	59.5	Medium.
889	....do	....do	Foster & Thompson	Kleinwanzlebener	45	10.1	71.1	Medium.
890	....do	....do	....do	....do	23	8.3	79.1	Medium.
820	....do	....do	N. T. Smith		43	9.5	71.4	Medium.
79	Clay	Bloomingdale	J. T. Olson	Vilmorin's Improved	25	10.3	73.0	Yes.
742	Grant	Milbank	H. W. Bailey	Kleinwanzlebener	20	9.8	73.6	Yes.
23	Jerauld	Woonsocket	W. M. Posey	....do	28	8.9	64.8	No.
576	....do	Parsons	L. G. Wilson	....do	5	11.6	75.8	No.
975	Meade	Sturgis	J. Shoudy	....do	26	16.3	81.2	Yes.
114	Yankton	Yankton	Yankton Beet Sugar Company	Vilmorin's Improved	22	12.7	78.4	Yes.
361	....do	....do	....do	....do	18	10.9	73.3	Yes.
	State averages (11 samples).				25	10.6	72.8	
	TENNESSEE.							
50	Hamilton	Fairmount	H. W. Estill		48	9.4	71.7	No.
345	Lawrence	Mackeson	A. A. Hogan		59	7.1	63.5	
	State averages (2 samples).				54	8.3	67.6	
	TEXAS.							
44	Stephens	Breckenridge	W. A. Craighead	Kleinwanzlebener	11	9.1	57.8	No.
45	....do	....do	....do	....do	12	8.4	50.9	No.
20	Wharton	El Campo	J. A. Nickelson	Vilmorin's Improved	12	4.9	52.5	No.
	State averages (3 samples).				12	7.5	53.7	
	UTAH.							
845	Boxelder	Brigham	L. J. Lund		42	16.3	87.3	No.
811	Cache	Logan	Utah Experiment Station	Mangold	9	16.1	88.1	Medium.
809	....do	....do	....do	Vilmroin's Improved	9	15.1	83.3	Medium.
873	Sevier	Richfield	P. Poulsen	....do	17	15.6	75.2	No.
638	Utah	Payson	J. Amos		14	14.4	86.9	Medium.
630	....do	....do	....do		15	16.2	86.7	Medium.
448	Weber	Hooper	J. T. Smith	Kleinwanzlebener	38	14.1	81.3	No.
409	....do	Huntsville	L. Peterson	....do	12	14.1	82.7	No.
451	....do	Hooper	D. C. Shaw	....do	33	15.2	82.0	No.
918	....do	Huntsville	M. C. Wangsgard		9	13.3	82.0	No.
	State averages (10 samples).				20	15.0	83.6	

Results of analyses of sugar beets at the chemical laboratory of the Department of Agriculture during the year 1899, by States—Continued.

Serial number.	State or Territory and County.	Post office.	Experimenter.	Variety.	Average weight.	Sugar in the beet.	Purity.	Was season favorable?
	VERMONT.				*Ounces.*	*Per cent.*	*Per cent.*	
745	Adison	Middlebury	S. W. Jewett	Kleinwanzlebener	33	12.8	80.4	Yes.
762	do	do	do	do	24	14.4	80.3	No.
355	do	West Cornwall	W. H. Binghum		38	12.7	75.3	No.
389	Bennington	Rupert	B. Harwood	Kleinwanzlebener	10	9.5	70.9	No.
419	Chittenden	St. George	H. H. Tilley	Vilmorin's Improved	13	14.2	83.3	Yes.
425	do	Williston	S. N. Tilley		34	13.3	78.2	Yes.
182	Franklin	St. Albans	E. S. Brigham	Vilmorin's Improved	24	12.6	78.7	No.
862	do	Buck Hollow	D. Buck	do	30	13.9	83.9	No.
681	Orange	West Brookfield	S. R. Blanchard	Kleinwanzlebener	20	12.2	80.5	No.
679	do	do	do	do	12	11.3	76.7	No.
337	Orleans	West Charleston	J. C. Oliver	Zehringen	21	12.6	76.5	No.
159	Rutland	North Clarendon	Geo. A. Senier	do	23	13.1	80.2	No.
427	Windham	Vernon	E. O. Lee	Kleinwanzlebener	11	13.1	82.6	Yes.
580	do	Guilford Center	W. G. Worden	Zehringen	22	13.5	78.5	Yes.
566	do	do	C. W. Weymouth	Kleinwanzlebener	17	11.2	75.2	Yes.
748	do	Bellows Falls	C. E. Webb		32	13.8	82.4	Yes.
	State averages (16 samples).				23	12.8	79.0	
	VIRGINIA.							
243	Albemarle	Charlottesville	W. C. Chamberlain	Kleinwanzlebener	10	10.7	75.4	No.
244	do	do	do	do	4	10.0	81.4	No.
306	Dinwiddie	Marmora	J. Gedivy	do	12	11.0	77.9	No.
184	Gloucester	Achilles	B. A. Rowe	do	38	8.3	75.0	Yes.
360	Henrico	Glendale	J. C. Garthright	do	12	8.6	68.2	No.
848	do	Richmond	do		24	8.3	67.0	Yes.
	State averages (6 samples).				17	9.5	74.2	
	WASHINGTON.							
934	Cowlitz	Toutle	C. N. Rogers	Vilmorin's Improved	18	12.1	76.5	Yes.
508	Lincoln	Crescent	O. Wollweber	Zehringen	30	14.4	80.3	No.
503	do	do	do	do	16	16.0	82.4	No.
430	Snohomish	Wallace	J. A. Brixner	Kleinwanzlebener	29	12.3	74.5	No.
560	do	Edmonds	F. H. Darling	do	27	10.8	72.6	No.
647	do	Arlington	W. A. Handley	do	31	14.9	84.9	No.
730	Spokane	East Spokane	C. F. Stokes	Vilmorin's Improved	23	9.2	73.5	No.
736	Stevens	Valley	Mrs. M. A. Kuehn	Zehringen	8	14.3		
	State averages (8 samples).				23	13.0	77.8	

	WEST VIRGINIA.							
987	Monroe ♀	Sinks Grove	J. A. Lee	Kleinwanzlebener	11	10.3	71.1	Yes.
418	Upshur □	Lorentz	I. J. Bargerhuff	....do	8	10.1	71.1	No.
335	....do	Buckhannon	G. R. Latham	Zehringen	41	6.8	59.5	Yes.
	State averages (3 samples).				20	9.1	67.2	
	WISCONSIN.							
208	Ashland ♁	Ashland	F. K. Zehr	Kleinwanzlebener	16	13.4	80.6	No.
522	Brown ♑	West Green Bay	J. De Witt		13	12.4	79.3	No.
964	....do	Green Bay	M. Lausen	Kleinwanzlebener	20	13.8	81.5	No.
317	Dane ♀	Madison Experiment Station.	Prof. F. W. Woll	Vilmorin's Improved	13	13.4	80.6	Yes.
329	....do	....do	....do	Kleinwanzlebener	13	14.7	84.3	Yes.
328	....do	....do	....do	....do	15	16.1	83.3	Yes.
327	....do	....do	....do	Pitzschke Elite	15	16.3	82.6	Yes.
326	....do	....do	....do	Kleinwanzlebener	14	15.2	82.5	Yes.
325	....do	....do	....do	Zehringen	13	16.1	82.1	Yes.
324	....do	....do	....do	Vilmorin's Improved	13	14.8	87.2	Yes.
323	....do	....do	....do	....do	14	16.7	81.9	Yes.
322	....do	....do	....do	Rölker Dippe Elite Kleinwanzlebener.	16	15.8	82.6	Yes.
321	....do	....do	....do	Mangold	13	14.4	81.3	Yes.
320	....do	....do	....do		15	14.4	80.8	Yes.
319	....do	....do	....do		15	14.1	80.0	Yes.
318	....do	....do	....do	Kleinwanzlebener	16	16.5	84.1	Yes.
455	Door ♂	Sturgeon Bay	J. E. Marshall		49	14.3	79.4	Medium.
426	Eau Claire ♄	Eau Claire	S. S. Hoyem		29	13.0	79.6	Yes.
604	Jefferson ♂	Palmyra	W. Morris	Zehringen	18	12.0	77.9	No.
388	Juneau □	Mauston	J. E. Palmer		24	12.0	78.3	Yes.
650	....do	....do	J. H. Herriot		8	12.4	77.8	No.
174	Milwaukee ♌	Sommerville	P. J. Mackedon	Vilmorin's Improved	41	11.5	78.1	Yes.
546	....do	....do	....do	Kleinwanzlebener	42	13.7	79.6	Yes.
249	Rock ♀	Union	S. H. Frost	Vilmorin's Improved	30	12.7	79.8	Yes.
985	Waukesha ♌	Sussex	C. J. Will	....do	33	15.5	81.9	Yes.
	State averages (25 samples).				21	14.8	84.4	
	WYOMING.							
810	Sheridan ♁	Dayton	R. A. Frazier	Zehringen	29	15.9	81.9	Yes.
	State averages (1 sample).				29	15.9	81.9	

DISCUSSION OF THE DATA.

ARKANSAS.

The samples of beets received from Arkansas were extremely poor. Even in cases where the beets were abnormally small, as in the samples from Nevada County, the percentage of sugar was very small. In all cases the purity was extremely low and was not so high as is found in molasses resulting from the separation of sugar from beets of good quality.

The data obtained during the past year corroborate the opinion previously expressed that Arkansas is entirely too far south to be regarded as among the possibilities for successful beet-sugar production.

CALIFORNIA.

Only one sample was received from California—from San Bernardino County. This sample was rather undersized, weighing only 11 ounces. Its content of sugar and coefficient of purity were good.

The possibility of growing rich sugar beets with high purity in California has been demonstrated so often as to remove all doubt.

COLORADO.

Sixty-four samples were received from Colorado, representing all parts of the State, as will be seen from an inspection of the relative positions of the counties given.

The average weight of the beets received was 24 ounces, which is rather above the ordinary. The content of sugar in the beets received was very high and the purity satisfactory.

It is evident that the climatic conditions in Colorado are extremely favorable to the production of beets of high quality. The only difficulty to be overcome is in regard to the water supply. Wherever irrigation can be practiced it is evident that there is a great future for sugar-beet production in Colorado.

CONNECTICUT.

Only two samples were received from this State, and the result of the analyses of these showed that they were unsatisfactory. Theoretically, beets of high quality should be grown in Connecticut, and doubtless could be if the proper attention were given to the subject. There is, however, little interest taken in the State in connection with the sugar-beet industry, and no determined effort to secure elaborate data covering the whole of the State has ever been made.

DELAWARE.

Two samples were received from the southern part of the State, and they showed fairly good qualities. It is evident that beets of good quality can be grown on the Atlantic seaboard. This has already been

shown in previous publications of this Department and in maps giving the probable areas suited to beet culture. It is doubtful, however, whether the State of Delaware, as a whole, would be well suited to beet-sugar production.

DISTRICT OF COLUMBIA.

The samples analyzed were grown in the Department grounds. Owing to the failure to secure a proper stand, the beets were somewhat overgrown.

The percentage of sugar and the coefficient of purity were both very low. It is evident that the District of Columbia is totally unfit to grow beets of high quality.

GEORGIA.

Fourteen samples of beets were received from Georgia, showing both the percentage of sugar and coefficient of purity below the standard for successful beet-sugar production. Nevertheless, with samples such as are represented in the tables, a fairly good quality of sugar can be made.

In three instances the samples showed an encouraging content of sugar, and in one case, namely, that of Cobb County, in the northern part of the State, both the percentage of sugar and the coefficient of purity were abnormally high. These exceptional cases, however, should not be construed as meaning that Georgia is a State suited for growing sugar beets for commercial purposes.

IDAHO.

The sample received from Idaho was exceedingly overgrown, and therefore should not be regarded in any sense as a typical sample.

ILLINOIS.

Twenty-five samples were received from Illinois and were unusually poor for that State, showing qualities less favorable even than those exhibited in the samples from Georgia. Only in four or five cases were the samples up to or above the standard. It is evident that better success must attend the efforts to grow sugar beets in Illinois than is indicated in these samples before it can be asserted that beets can be grown there with a profit for commercial purposes in sugar making.

INDIANA.

The twenty-nine samples received from this State showed poor qualities both in content of sugar and coefficient of purity. Only a small percentage of the samples reached or went beyond the standard, and the coefficients of purity especially were phenomenally low for that State.

Indiana theoretically should make a better showing than is given by the analyses of the present year.

IOWA.

Sixty-seven samples were received from the State of Iowa and the mean result of the analyses showed very poor qualities both in sugar content and in purity.

There seems to be no good reason for this poor showing, and it is rather perplexing that this State, which is so favorably situated theoretically for the growing of sugar beets, should be represented by samples which exhibit even poorer qualities than are found in the samples received from Indiana and Illinois. The data from these three States show that even where, in general, favorable conditions obtain there may be seasons when the quality of the product falls far below the average.

KANSAS.

The thirty-five samples from Kansas showed in their analytical data that the previously expressed opinions in regard to Kansas' being a State where beets can not be successfully grown are correct.

KENTUCKY.

Only one sample was received from Kentucky. This was small and its low sugar content would make it valueless for the production of sugar.

MARYLAND.

Eighteen samples showed beets of rather poor qualities, not reaching the standard either in sugar content or coefficient of purity. These data confirm the impression made by the analyses of previous years, to the effect that Maryland can not be regarded as a competitor with the more favored States in the manufacture of sugar from beets.

MASSACHUSETTS.

Nine samples from Massachusetts showed beets of very high quality both in sugar content and purity coefficient.

MICHIGAN.

By far the largest number of samples received during the last year came from Michigan, in all 236. The average size of these beets was satisfactory, the average weight being 22 ounces. The average percentage of sugar in the beet was encouraging, being over 13.1. The purity fell by a small amount below the standard which is set for this number, namely, 80.

It is evident from these analyses and from others which have been obtained that this State is most favorably situated for the successful production of beets for sugar-making purposes.

MINNESOTA.

The nine samples received from this State showed a surprising content of sugar but very low purity.

MONTANA.

Many of the samples received from Montana were immensely overgrown and hence the low content of sugar and purity coefficient were not surprising.

The State of Montana is capable of growing beets of high sugar content and high purity when the proper conditions of cultivation and fertilization are observed.

NEBRASKA.

The six samples from this State showed both the content of sugar and coefficient of purity slightly below the accepted standard.

NEVADA.

The twenty-four samples received from this State confirmed the opinion previously formed, that if the proper conditions of water supply can be secured, Nevada will be one of the greatest beet-sugar producing States of the Union. The content of sugar in the beets was phenomenal and the purity very satisfactory.

NEW HAMPSHIRE.

The four samples of beets received from this State showed most excellent qualities both in the sugar content and purity.

In so far as seasonal conditions are concerned, it is evident that New Hampshire will be able to produce beets of exceptionally good qualities for sugar-making purposes.

NEW JERSEY.

The seventeen samples received showed beets considerably overgrown, with a satisfactory content of sugar and a purity which lacked less than three points of reaching the minimum standard. The showing for New Jersey was exceptionally fine. A very little improvement in the quality of the beets, as shown by the analyses of the samples received, will make beet-sugar manufacture in this State profitable.

NEW MEXICO.

The two samples from New Mexico showed a good weight, a high content of sugar, and a satisfactory purity.

NEW YORK.

New York, next to Michigan, furnished the largest number of samples. The results of the analyses are very satisfactory, so far as the content of sugar is concerned, but for some reason the purity of the beets received from New York this year falls a little over one point below the minimum standard.

NORTH CAROLINA.

The two samples showed beets of low sugar content and low purity.

NORTH DAKOTA.

Three samples showed a very satisfactory content of sugar and a purity slightly below the standard.

OHIO.

Ohio comes third in the number of samples forwarded for analysis during the year 1899. The 128 samples received showed beets somewhat above the average in size, only slightly below the standard for sugar content, and with a coefficient of purity only four points below what it should be.

It is evident that Ohio is capable of growing beets of high quality, but the efforts in this direction should be confined to the more northern portions of the State. The same statement is true of the States of Indiana and Illinois. The growing of beets in the southern parts of these States tends to lower the general average for the whole States.

OKLAHOMA.

The two samples received showed the beets to be very much overgrown, with a low content of sugar and very low purity. Oklahoma is too far south for successful sugar-beet production.

OREGON.

The single sample received from this State showed fine qualities both in content of sugar and purity coefficient.

PENNSYLVANIA.

The twenty-eight samples received from Pennsylvania showed beets very much overgrown. The low content of sugar and the low purity revealed by the analytical data are not surprising, considering the abnormal size of the beets.

SOUTH CAROLINA.

The four samples received from the northwestern portion of the State showed exceptionally fine qualities for the South. The content of sugar was very satisfactory and the purity almost up to the standard. It is evident that in those portions of South Carolina near the mountains, where the altitude is great, beets of fine quality can be produced. The same remark can be applied to the other Southern States where advantage can be taken of the mountainous regions to grow beets at a high altitude.

SOUTH DAKOTA.

The eleven samples received from this State showed the beets to be somewhat overgrown and with a very low content of sugar and purity for that locality.

TENNESSEE.

The two samples showed beets enormously overgrown, and, as a consequence, of very low purity and very low sugar content.

TEXAS.

The three samples received showed beets of very poor quality, both in respect of sugar content and purity.

UTAH.

Ten samples received showed beets of very high grade. The size of the beets was almost ideal, the content of sugar high, and the coefficient of purity nearly four points above the minimum standard.

VERMONT.

The sixteen samples showed beets of good size, satisfactory sugar content, and a purity only one point below the minimum standard.

VIRGINIA.

Six samples from Virginia showed beets of average size, but with quite low content of sugar and low purity.

Except in the elevated plateaus of Virginia, it is not to be expected that beets can be successfully grown.

WASHINGTON.

Eight samples showed beets of satisfactory sugar content, but with a purity a little over two points below the standard.

WEST VIRGINIA.

Three samples indicated that the beets were of poor quality, both in respect of sugar content and purity. There are many elevated plateaus, especially in the Alleghany Mountains, where very fine beets could be grown.

WISCONSIN.

Twenty-five samples received from this State showed beets a little above the average in size, having a very high content of sugar and exceptionally high purity.

WYOMING.

The single sample received from Wyoming was very much overgrown, but in spite of this fact the content of sugar was exceptionally high and the purity very satisfactory.

COMPARISON OF THE DATA OBTAINED DURING THE THREE YEARS 1897, 1898, AND 1899.

Since it is well understood that the data for a single season do not form a reliable criterion, owing to certain meteorological influences, it is advisable always to collect the results which have extended over a longer time. During the three years that the investigation has been conducted by the present Secretary of Agriculture there have been obtained data which are of greater use when studied as a whole. To this end the average results extending over the period mentioned have

been collected, but in many instances the data are not complete for the three years, and in these cases the comparison is of less value. The table following shows the number of samples secured, the average weight of the samples in ounces, the percentage of sugar in the beet, and the purity for each year named. The average for the three years is obtained by multiplying the data for each year by the number of samples for that year, taking the sum of the products and dividing by the total number of samples for the three years. The mean data, in general, corroborate the results obtained in the several years.

Average weight, percentage of sugar, and purity of samples of sugar beets, by States and Territories, for the years 1897, 1898, 1899.

States.	Year.	Number of samples.	Average weight.	Sugar in the beet.	Purity coefficient.
			Ounces.	*Per cent.*	
Arkansas	1897	2	18	11.3	71.5
	1898	6	23	7.1	67.5
	1899	5	15	6.0	55.5
Average for the three years		13	19	7.3	63.5
California	1897	1	26	16.8	.....
	1898	4	25	14.6	80.2
	1899	1	11	13.9	82.0
Average for the three years		6	23	14.9	80.6
Colorado	1897	174	20	13.6	76.7
	1898	50	22	13.7	80.1
	1899	64	24	14.4	80.2
Average for the three years		288	21	13.8	78.1
Connecticut	1897	.....	.....	.....	.....
	1898	4	21	10.3	76.2
	1899	2	17	10.9	75.5
Average for the three years		6	20	10.5	76.0
Delaware	1897	.....	.....	.....	.....
	1898	1	14	11.3	78.8
	1899	2	24	12.5	81.4
Average for the three years		3	21	12.1	80.5
District of Columbia	1897	.....	.....	.....	.....
	1898	.....	.....	.....	.....
	1899	4	24	6.4	56.9
Average for the three years		4	24	6.4	56.9
Georgia	1897	.....	.....	.....	.....
	1898	4	47	5.8	64.0
	1899	10	14	11.0	75.0
Average for the three years		14	23	9.5	71.9
Idaho	1897	7	21	12.5	79.4
	1898	5	28	12.0	78.3
	1899	1	36	10.8	75.0
Average for the three years		13	25	12.2	78.6
Illinois	1897	32	17	13.1	75.5
	1898	38	20	10.2	75.2
	1899	25	25	10.6	72.6
Average for the three years		95	20	11.3	74.6
Indiana	1897	103	14	13.1	78.9
	1898	88	21	10.1	75.5
	1899	29	19	11 4	73.4
Average for the three years		220	17	11.7	76.8

Average weight, percentage of sugar, and purity of samples of sugar beets, by States and Territories, for the years 1897, 1898, 1899—Continued.

States.	Year.	Number of samples.	Average weight.	Sugar in the beet.	Purity coefficient.
			Ounces.	*Per cent.*	
Iowa	1897	130	18	13.3	73.7
	1898	147	25	11.4	76.1
	1899	67	24	10.9	72.1
Average for the three years		344	22	12.0	74.4
Kansas	1897	41	27	11.4	73.8
	1898	16	22	10.3	71.3
	1899	35	21	9.5	66.0
Average for the three years		92	24	10.5	70.4
Kentucky	1897	6	16	11,9	71.5
	1898	4	14	5.9	61.1
	1899	1	5	7.4	.....
Average for the three years		11	14	9.3	67.3
Maryland	1897	29	19	11.4	79.1
	1898	31	22	10.4	76.0
	1899	6	18	10.2	74.6
Average for the three years		66	20	10.8	77.2
Massachusetts	1897	.....	.....	.....	.....
	1898	4	27	12.0	78.6
	1899	9	21	14.6	83.3
Average for the three years		13	22	13.8	81.9
Michigan	1897	450	22	14.7	81.1
	1898	34	28	13.2	81.9
	1899	236	22	13.1	79.7
Average for the three years		720	22	14.1	80.7
Minnesota	1897	49	24	11.0	79.2
	1898	21	22	12.7	78.7
	1899	9	23	12.3	77.5
Average for the three years		79	23	11.6	78.9
Missouri	1897	324	20	11.7	73.5
	1898	43	17	8.5	68.6
	1899	19	17	7.1	64.3
Average for the three years		386	20	11.1	72.1
Montana	1897	4	20	14.4	77.8
	1898	7	21	11.2	72.6
	1899	2	40	10.7	70.6
Average for the three years		13	24	12.1	73.9
Nebraska	1897	13	29	12.9	76.9
	1898	10	25	12.8	76.8
	1899	6	19	11.3	74.4
Average for the three years		29	26	12.5	76.3
Nevada	1897	21	18	18.3	81.4
	1898	42	12	18.5	85.9
	1899	24	18	16.9	82.2
Average for the three years		87	15	18.0	83.8
New Hampshire	1897	.....	.....	.....	.....
	1898	2	34	13.5	83.5
	1899	4	17	15.5	86.0
Average for the three years		6	23	14.8	85.2
New Jersey	1897	31	16	14.2	81.4
	1898	33	20	11.1	77.5
	1899	17	27	11.3	77.3
Average for the three years		81	20	12.3	79.0

Average weight, percentage of sugar, and purity of samples of sugar beets, by States and Territories, for the years 1897, 1898, 1899—Continued.

States.	Year.	Number of samples.	Average weight.	Sugar in the beet.	Purity coefficient.
			Ounces.	*Per cent.*	
New Mexico	1897	3	13	17.2	82.0
	1898	7	20	12.8	78.0
	1899	2	22	14.9	82.9
Average for the three years		12	19	14.3	79.8
New York	1897	225	21	15.0	82.4
	1898	328	21	12.6	80.5
	1899	142	19	13.0	78.8
Average for the three years		695	21	13.5	80.8
North Carolina	1897	7	23	9.1	75.3
	1898	14	19	6.5	61.8
	1899	2	17	7.6	69.0
Average for the three years		23	20	7.4	66.5
North Dakota	1897	4	28	10.5	.....
	1898	.....	.....	.....	.....
	1899	3	22	13.9	78.3
Average for the three years		7	25	12.0	78.3
Ohio	1897	68	22	13.8	79.1
	1898	409	24	11.0	77.1
	1899	128	24	11.9	76.1
Average for the three years		605	24	11.5	77.1
Oklahoma	1897	1	10	11.8	72.5
	1898	6	24	10.2	73.3
	1899	2	31	10.3	69.3
Average for the three years		9	24	10.4	72.3
Oregon	1897	.....	.....	.....	.....
	1898	6	20	14.1	83.4
	1899	1	17	15.8	84.3
Average for the three years		7	20	14.3	83.5
Pennsylvania	1897	59	18	13.8	79.5
	1898	81	21	11.6	78.1
	1899	28	31	11.2	75.4
Average for the three years		168	22	12.3	78.1
South Carolina	1897	13	17	9.9	79.9
	1898	4	14	10.2	81.2
	1899	4	14	13.0	79.3
Average for the three years		21	16	10.5	80.0
South Dakota	1897	5	17	15.1	83.2
	1898	24	16	13.9	78.6
	1899	11	25	10.6	72.8
Average for the three years		40	19	13.1	77.6
Tennessee	1897	17	11	10.8	71.9
	1898	10	17	8.0	69.3
	1899	2	54	8.3	67.6
Average for the three years		29	16	9.7	70.7
Texas	1897	11	22	12.6	76.5
	1898	49	25	9.5	69.8
	1899	3	12	7.5	53.7
Average for the three years		63	24	10.0	70.2
Utah	1897	35	20	14.3	81.1
	1898	14	16	13.6	85.3
	1899	10	20	15 0	83.6
Average for the three years		59	14	14.3	82.5

Average weight, percentage of sugar, and purity of samples of sugar beets, by States and Territories, for the years 1897, 1898, 1899—Continued.

States.	Year.	Number of samples.	Average weight.	Sugar in the beet.	Purity coefficient.
			Ounces.	*Per cent.*	
Vermont	1897	8	22	14.2	84.1
	1898	68	22	13.2	82.8
	1899	16	23	12.8	79.0
Average for the three years		92	22	13.2	82.3
Virginia	1897	34	21	11.6	76.2
	1898	43	20	8.9	72.4
	1899	6	17	9.5	74.2
Average for the three years		83	20	10.0	74.1
Washington	1897	34	27	13.7	80.7
	1898	5	27	13.9	81.3
	1899	8	23	13.0	77.8
Average for the three years		47	26	13.6	80.3
West Virginia	1897	14	19	15.4	80.4
	1898	4	28	9.1	72.9
	1899	3	20	9.1	67.2
Average for the three years		21	21	13.3	77.1
Wisconsin	1897	42	15	15.8	83.3
	1898	16	24	13.0	79.3
	1899	25	21	14.8	84.4
Average for the three years		83	19	15.0	82.9
Wyoming	1897	34	19	17.2	82.3
	1898	10	19	13.9	78.1
	1899	1	29	15.9	81.9
Average for the three years		45	19	16.4	81.4

ARKANSAS.

Thirteen samples have been examined during the three years from this State. The average percentage of sugar in the beet was 7.3, and the average coefficient of purity 63.5. It is evident that sugar can not be profitably made from sugar beets of this character.

CALIFORNIA.

The number of samples from this State was so small as to render the data of little value. The general results, however, confirm the opinion that the capabilities of growing sugar beets of high quality in the State are without question.

COLORADO.

During the three years 288 samples have been analyzed from Colorado. The percentage of sugar in the general average was satisfactory, but the purity for the whole period was slightly below the standard.

CONNECTICUT.

The remark which was made above in regard to the data from California applies with equal force to the results obtained from the samples received from Connecticut.

DELAWARE.

No valuable deduction can be drawn from the three samples which have been analyzed in two years from Delaware.

DISTRICT OF COLUMBIA.

The results of only one year's work proves as stated in another place, that the District of Columbia is totally unfit to grow beets of high quality.

GEORGIA.

The analyses of fourteen samples from Georgia, extending over a period of two years, gave some little indication of the capability of sugar-beet growing in the State. The results were not encouraging.

IDAHO.

Analyses of thirteen samples from Idaho showed beets to be somewhat overgrown, with a fair content of sugar and a purity slightly below the standard.

ILLINOIS.

Ninety-five samples have been received from Illinois during the three years mentioned. The average size of the beets was normal, but both the content of sugar and coefficient of purity were below the standard.

INDIANA.

Two hundred and twenty samples received from Indiana showed that this State has practically the same rank as a sugar-beet producer as Illinois.

Attention has already been called to the fact that in Indiana and Illinois a successful beet-sugar industry can be established only in the northern parts. It is not advisable to try to push the commercial growing of sugar beets even so far south as the central portions of these States.

IOWA.

Three hundred and forty-four samples were received from Iowa, showing beets of good size and a good content of sugar, just reaching the average standard fixed for successful manufacture. The purity of the Iowa beets is remarkably low, when their content of sugar is considered. This fault can doubtless be remedied by more careful culture.

KANSAS.

The climate of Kansas, as has been repeatedly pointed out, is not suitable to the growing of high-grade sugar beets. The summers, as a rule, are too long and too dry. The data which have been secured from the ninety-three samples received from that State confirm this statement.

KENTUCKY.

Eleven samples of beets grown in this State have been examined. Their uniformly low sugar content and purity are not encouraging.

MARYLAND.

Maryland appears to be one of those States which is just on the border separating the good from the indifferent areas for sugar-beet production. There are many parts of Maryland where high-grade beets can be grown. This is especially true of the high plateau lands of the Alleghany Mountains. On the Atlantic seaboard, also, beets of high grade can be grown in Maryland. The sixty-six samples secured from this State showed both the sugar content and purity below the standard fixed for successful culture.

MASSACHUSETTS.

The number of samples which have been received from Massachusetts—namely, thirteen—is too small to serve as a foundation for any definite conclusions. It is evident, however, where the soil conditions are favorable, that beets of high quality can be grown. The analytical data obtained from the Massachusetts samples were very satisfactory, both as regards sugar content and purity.

MICHIGAN.

In the case of Michigan, the number of samples received was so large as to make the deductions therefrom very valuable. It will be seen that the beets were of good size, with an exceptionally high content of sugar and purity.

There is little doubt of the fact that Michigan is one of the most favorable localities in the United States for the growing of high-grade sugar beets. When the farmers of the State thoroughly learn the art of successful beet culture, they will be able to compete even with the more favored districts of Europe, both in the quality of the beets produced and in the yield per acre.

MINNESOTA.

The data obtained from Minnesota were not so favorable as theoretical indications would lead one to expect. The analyses of seventy-nine samples indicated beets of very uniform and almost ideal size from the point of view of the farmer and the manufacturer. The content of sugar was slightly below the minimum standard, and the same remark can be applied to the purity coefficient.

MISSOURI.

Missouri, as in the case of Maryland, is one of the border States between the good and bad areas for successful beet culture.

The 385 samples received during the three years showed beets of good average size, with a fair content of sugar but a low purity. The

general result of the study of the data received from Missouri was distinctly unfavorable, and points to the fact that it is not a suitable region for the successful growing of sugar beets.

MONTANA.

The results obtained from the few samples received from Montana indicated that in the beets grown there so far the percentage of sugar and the purity were very much below the average.

NEBRASKA.

Many years of the commercial culture of the sugar beet have distinctly fixed the status of Nebraska in respect to this industry. The data obtained from this region showed beets of fair sugar content but rather low purity. It has been demonstrated that beet sugar can be made in Nebraska, but it is evident from the data for the last few years that Nebraska does not rank as high as some of the other States in its capability of raising high-grade sugar beets.

NEVADA.

Although Nevada is not regarded as an agricultural State, it is evident from the data secured that if irrigation should be practiced over considerable areas there is no State in the Union more favorable to the growing of high-grade beets. In fact the data obtained from the eighty-seven samples secured from that State are the most favorable of any obtained anywhere in the country. The remarkably high content of sugar in the beet, coupled with the high purity, more than offsets the rather small size of the beet produced. It is evident that in a State like Nevada, where expensive cultivation is essential, no crop could be produced so profitably as the sugar beet, provided the conditions of manufacture are favorable, the factories not being too far removed from the sources of supply.

NEW HAMPSHIRE.

The few samples received from this State showed beets of very high grade. It is not likely, however, owing to the contour of the State and the character of the soil, that beet culture will ever become an industry of great magnitude in that region.

NEW JERSEY.

Eighty-one samples have been received from the State of New Jersey. The size of the beets and the content of sugar were favorable and the purity almost up to the standard. It is evident that portions of New Jersey are favorable to the growing of beets which could be profitably used for sugar making.

NEW MEXICO.

Only a few samples were received from this Territory. The content of sugar in the beets from this region was favorable, and the purity

almost up to the standard. In the commercial growing of sugar beets in this Territory difficulties have been met which have discouraged the growers to some extent, but it is believed that there are many areas in New Mexico where successful beet culture can be carried on.

NEW YORK.

Great interest has been manifested in the State of New York during the last few years in the sugar-beet industry, and two factories have been in operation. Both of the experiment stations, the one at Cornell University and the State station at Geneva, have investigated the subject of beet culture and have secured data of a very valuable nature.

The data obtained here during the three years are also very favorable, especially so because based upon so large a number of samples, namely 695. While the content of sugar is not phenomenal, it is high enough to make a profitable yield, and the purity is satisfactory.

NORTH CAROLINA.

The samples received from this State showed beets of very poor quality. There are doubtless areas in the mountain regions where fine beets can be grown, but in the lowlands it is evident that the climatic conditions are unfavorable.

NORTH DAKOTA.

The small number of samples received from this State makes any deductions in regard to the beets grown there unreliable. The data, however, when considered with those obtained from the agricultural experiment station, show that successful beet culture can be practiced in North Dakota where the local conditions are favorable.

OHIO.

The large number of samples received from Ohio enables us to form definite judgments in regard to the possibility of beet culture in that State. The same remark which has been made in regard to Illinois and Indiana is applicable to Ohio. The State as a whole can not be regarded as favorable to beet culture. There are many places in the northern part where beets of high quality could be produced on a commercial scale.

OKLAHOMA.

The data from this Territory are distinctly unfavorable. The conditions which obtain there are very much the same as in Kansas, and the Territory is not suitable to the growth of high-grade sugar beets.

OREGON.

The data from the few samples received from this State are of little value when considered alone. When, however, those obtained from the agricultural experiment station are taken into account, it is evident that in Oregon, at least in certain portions of it, there are areas well suited to the production of beets of very high grade.

PENNSYLVANIA.

Pennsylvania does not hold as high a rank as New York or Michigan in sugar-beet production, but it is evident from the data secured that the beets are of a quality sufficiently high to insure favorable results from the manufacture of sugar from beets grown in that State. The great trouble seems to lie with the coefficient of purity. This, however, doubtless can be raised by careful culture.

SOUTH CAROLINA.

The data obtained from this State were much more favorable than theoretical indications would lead one to suppose. The coefficient of purity in the South Carolina beets reaches the standard, while the content of sugar is not so much below the standard as might be expected. Nevertheless, it can not be said that South Carolina is among the number of those States where a successful sugar-beet industry can be established.

SOUTH DAKOTA.

The beets received from South Dakota had a fair content of sugar, but a low purity. It is evident that more careful culture must be practiced in order to raise the purity to the standard. When this is accomplished South Dakota can be considered as one of the localities favorable to beet production.

TENNESSEE.

There are many parts of Tennessee where the altitude is very great, but in these regions water is scarce and the land is devoted almost exclusively to grazing. In the parts of the State where agriculture is practiced it is evident that the conditions are unfavorable to the sugar-beet industry

UTAH.

The data from Utah showed favorable conditions. In connection with these data it must be taken into consideration that the sugar-beet industry has been established there on a successful commercial scale. This State can be regarded as one of the most favorable for beet production, and a rapid expansion of the industry will be seen there in the near future. The coefficient of purity shows that often under irrigation the beets have a juice of the finest quality which can be produced.

VERMONT.

The climatic conditions are favorable to the production of high-grade beets, as is clearly indicated by the data obtained. The contour of the State and the character of the soil, however, impose difficulties in the way of the expansion of the sugar-beet industry which will be hard to overcome.

VIRGINIA.

The samples received from this State were not encouraging to the belief that a successful sugar-beet industry can be established therein. There are doubtless many localities, especially in the mountainous regions, where exceptionally fine beets can be grown, but taken as a whole the State can not be regarded as among those where the future will see a successful beet-sugar industry established.

WASHINGTON.

Washington is in the same category as Oregon as a sugar-beet producing State. Perhaps the conditions as a whole are somewhat more favorable in Washington than in Oregon. The data obtained from the forty-seven samples showed a high content of sugar and a satisfactory purity.

WEST VIRGINIA.

There are many localities in West Virginia, especially among the mountains, where beets of high quality can be produced.

The twenty-one samples received did not correctly represent the possibilities of the State. During the year 1897 there were fourteen samples received from West Virginia of exceptionally high character. A study of the data obtained during the other two years showed the beets to be of very inferior character.

The mountainous areas of the State, where the climatic conditions are favorable, will not afford any considerable expansion of the industry.

WISCONSIN.

The data obtained from Wisconsin showed that it is one of the most favorable States of the Union for the growth of beets.

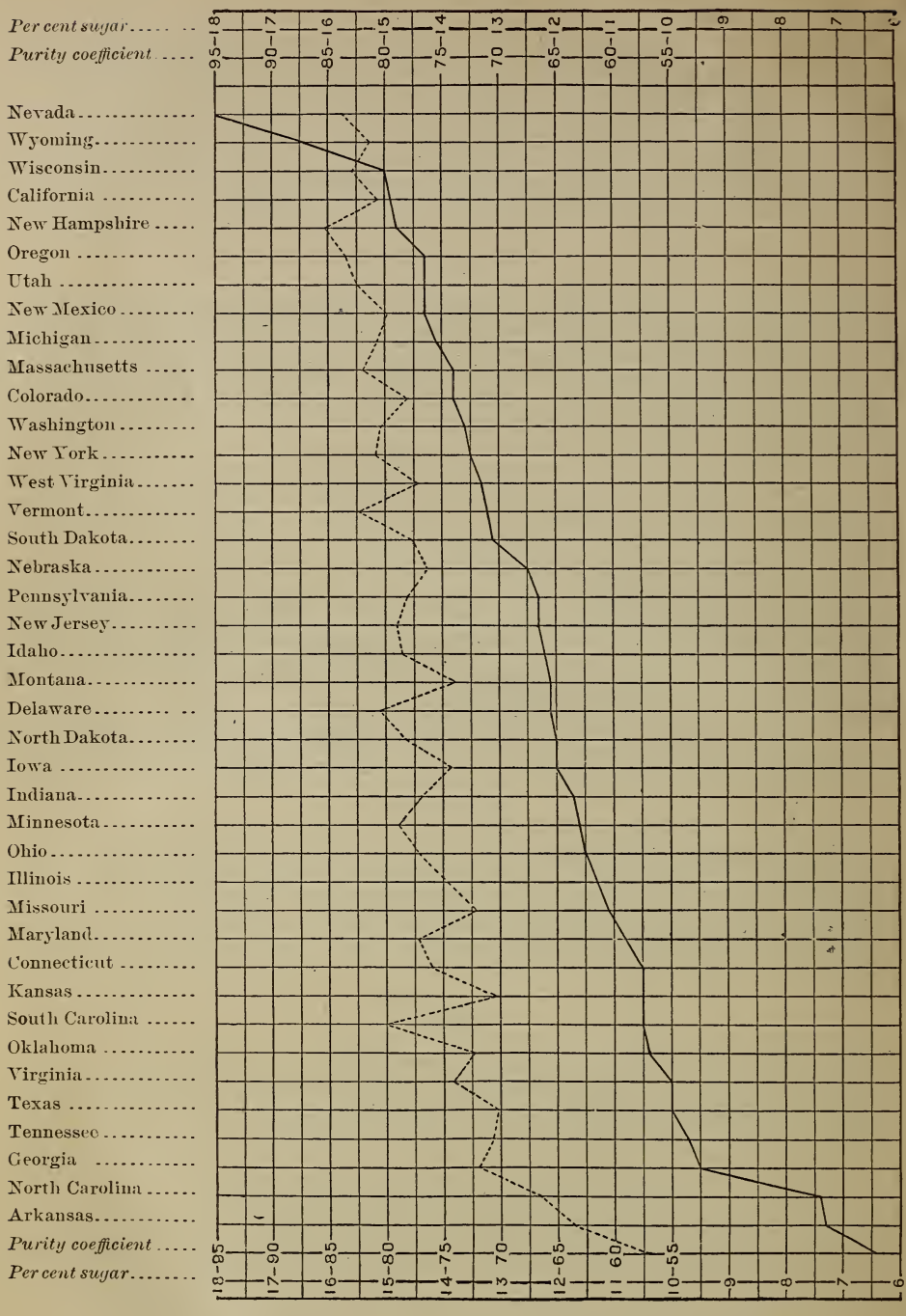
Eighty-three samples showed beets of ideal size, very high content of sugar, and the purity above the average.

WYOMING.

This State also contains many areas suited to beet culture. The forty-five samples which have been secured showed beets of exceptionally high sugar content and satisfactory purity.

DIAGRAMMATIC VIEW OF THE DATA.

In order to give a general view of the above data, a diagram (fig. 1) is presented showing the relative percentages of sugar in the beets grown in the several States and Territories by a continuous line, and the relative coefficients of purity of the juice of the beets by a broken line. For convenience, these lines have been placed upon the same cross-section paper. Of the two columns of figures appearing at each side, the outer shows the percentages of sugar, being numbered from 6 to 18, inclusive, and the inner represents the coefficients of purity, from 55 to 95, inclusive.



..... Purity coefficient. ——— Per cent of sugar in beets.

FIG. 1.—Diagram showing average percentage of sugar in the beet and average coefficient of purity of the juice as shown by analyses of samples received from States and Territories by the Department of Agriculture during the years 1897, 1898, and 1899.

An inspection of these lines will show that there is a general relationship between the percentages of sugar and the coefficients of purity. The continuous line showing the percentages of sugar is arranged in order, beginning with the lowest percentage of sugar, as found in beets grown in any State, namely, 7.3 per cent in Arkansas, and ending with the beets which exhibited the highest percentage of sugar, namely, those received from Nevada, having 18 per cent of sugar. The order in which the States come in this diagram is what would be expected from their geographical location, with the exception of the State of Connecticut. The samples received from this State were unusually poor, since it is certain that if the possibilities of beet growing in Connecticut were thoroughly studied the position of this State would be much farther to the right than in the present instance.

Since it was necessary to construct a line for the coefficients of purity in the same order of States as that representing the percentages of sugar, this line does not rise at regular intervals, from the lowest to the highest points, but is subject to fluctuations, as is seen in the irregular zigzags given.

Nevertheless, a comparison of the two lines shows that there is a tendency for a high purity to go with a high percentage of sugar.

A word of caution should be spoken in regard to the diagram, namely, that it must be considered as representing the actual character of the beets grown in the several localities mentioned only so far as the same is indicated by the data obtained in the analyses made in the Division of Chemistry of the Department of Agriculture during the years 1897, 1898, and 1899. The samples received from several of the States were insufficient in number to accurately indicate their capabilities for beet production.

INDEX.